INFORMATION UTILISATION: A COGNITIVE ANALYSIS OF HOW GIRLS UTILISE DRUG INFORMATION BASED ON BROOKES' FUNDAMENTAL EQUATION $K[S] + \Delta I = K[S + \Delta S]$

Ross J Todd

A THESIS SUBMITTED TO THE
UNIVERSITY OF TECHNOLOGY, SYDNEY
IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

FACULTY OF HUMANITIES AND SOCIAL SCIENCES

UNIVERSITY OF TECHNOLOGY, SYDNEY

1996

CERTIFICATE

I certify that this thesis has not already been submitted for any degree and is not being submitted as part of candidature for any other degree.

I also certify that the thesis has been written by me and that any help that I have received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

Signature of Candidate

Production Note:
Signature removed prior to publication.

DEDICATION

This dissertation is dedicated to my late parents Margaret and Cedric Todd.

They provided me with opportunities for learning and living they never had, and in these opportunities they found their own dreams and hopes.

When I said: *"a little knowledge is a dangerous thing"*,
they said: *"where is the person who has so much as to be out of danger?"*

(T. Huxley. On elemental instruction in physiology. 1877)

Through their world, their wisdom, and their work,
I have found a never-ending beginning, and I thank them for it.

ACKNOWLEDGMENTS

I wish to thank my Chief Supervisor, Professor Mairéad Browne, and my Co-supervisor, Susan Edwards for their sustained leadership and guidance during this dissertation. Their intellectual rigour, insight, challenge and enthusiasm have been greatly valued.

I also wish to thank the University of Technology, Sydney for making available to me time release in the Autumn Semester 1996 for full time study, and to my colleagues in the Department of Information Studies who carried my load in my absence.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

The central focus of this study is cognitive information utilisation. Research in information utilisation to date has largely focused on the organisational outcomes of the take up of scientific and professional information in the context of social practice, and the related political, cultural and economic factors affecting this. Conceptualising information utilisation as a type of organisational change or end-state has tended to mask the complex cognitive exchanges that occur. While there has been increasing acknowledgement that information utilisation is a more holistic interactive change process involving cognitive strategies and transformations, very little research has focused on the cognitive dimension of information utilisation.

Bertram Brookes claimed that the theoretical pursuit of information science should be the cognitive interaction between people and information. He explicated this as the Fundamental Equation of information science, most commonly expressed in his writings as $K(S) + \Delta I = K[S + \Delta S]$. By this equation, Brookes was stating that in the process of doing something with information, a person's existing knowledge structure K[S] is changed by an increment of information ΔI, and this modification has some effect, a changed knowledge structure $K[S + \Delta S]$ where ΔS indicates the effect of the modification. This equation is posited as an expression of cognitive information utilisation.

The specific purpose of this study is to further understanding of cognitive information utilisation, employing Brookes' Fundamental Equation as a general framework for establishing research questions, operationalisations and procedures. With a group of four girls in their final year of secondary education, the study sought to: (a) establish the effects ΔS of exposure to information perceived by the girls; (b) establish how the perceived effects are associated with changes to their knowledge structures K[S]; and (c)

establish the patterns, if any, within and between the girls in relation to changes in knowledge structures and perceived effects (K[S + ΔS]).

The study employed a quasi-experimental repeated phase approach. The girls' existing knowledge structures about the drug heroin were mapped, and knowledge structures after each of three exposures to different information on heroin were also mapped. Eliciting the girls' knowledge about heroin was based on written discourse and question / answer protocols, and this knowledge was represented as conceptual graph structures, based on an analytical procedure developed by Graesser & Clark (1985). The data were analysed qualitatively to establish indicators and conceptualisations of the perceived effects, and to identify and conceptualise the changed knowledge structures.

The study found that the exposures to information and the deliberate consideration of this information had effects for all the girls. Five types of effects were perceived, these being: *get a complete picture, get a changed picture, get a clearer picture, get a verified picture, and get a position in a picture.* These effects are presented as types of cognitive information utilisation. The knowledge structures after each exposure were shown to change by cognitive strategies of appending, inserting and deleting. The analysis of the knowledge structures associated with these five effects showed that there was coherence between the effects and how these effects were manifested in changes to the girls' knowledge structures. A number of distinct patterns were evident, for example, *get a complete picture* was associated with revised knowledge structures that were more inclusive, elaborative and integrative.

The study raises important implications for information practice, including data base design, information interviews, provision of information in media campaigns, and instructional design. The study also addresses methodological issues and identifies area for further research.

CHAPTER 1

INTRODUCTION

1.1 ORIGIN OF THE STUDY

The central focus of this study is the concept of cognitive information utilisation. Cognitive information utilisation is about what people do with information they are exposed to, how information changes what they know, and what are the cognitive effects of this interaction. Underpinning the study is the widely accepted assumption that information has the potential to change what people already know, and the belief that understanding more about how it changes people can contribute to more effective provision of information services and products. While aspects of the study are informed by the literature of cognitive psychology, knowledge representation and education, the disciplinary context of this study is information science.

In an examination of the foundations of information science, the late Laurence Heilprin spoke of the 20th century as the "Age of Information", an era characterised by the exponential growth, organisation and global distribution of information (1989: 364). He asserted that the generation, processing, provision and use of information has emerged as the predominant human activity, and that the study of information channels has become the locus of the development of laws, theories, generalisations and speculations that are the foundations of an information science.

In his analysis, Heilprin foreshadowed an "Age of the Mind" as a probable successor to the "Age of Information", an age of investigating the minds bounding the channels. He claimed that it is in these mental channels that all discovery, investigation and technological adaptation take place, and not in the nonliving connecting channels, and saw the need for increasing attention of information scientists to be directed to understanding these mental terminals as a basis for the effective organisation and provision of

information. Heilprin acknowledged the complexity of this investigation, recognising that channels are comparatively simple, easy to get at, and open to systematic study, whereas minds are complex, comparatively inaccessible, and not so open to study (Heilprin 1989: 346) .

Wersig has also called for the discipline to shift thinking about the information society from information occupations, information technology and information products, to "immaterial human needs, including the processing of information". Concerned about the "rubbish"-explosion through the explosion of large stores of "senseless data" and "useless literature", and concerned about the present day illiteracy levels, he urged a "back to knowledge"-direction and an information culture founded on understanding the relationship of information, people, senses, space and time (Wersig, 1990: 185, 197).

Against this backdrop, the origin of this study was an interest in the holistic study of the interaction of people and information, and a curiosity about how people create, process and make sense of information that surrounds them to enable them to get on with their lives. This curiosity is encapsulated in Baran & Davis' notion of how people deal with information:

> "Each day we are exposed to vast quantities of sensory information; we take in only a small fraction of it, process and use an even smaller fraction, and then we finally store a tiny fraction of this in long-term memory. According to some cognitive theorists, we are not so much information handlers as information avoiders. ... Very little of what goes on around us ever reaches our consciousness and most of this is soon forgotten" (Baran & Davis, 1995: 267).

The study has been shaped by three important interrelated trends which have developed in library and information science over the last two or three decades. Firstly, there has been the shift from a system-oriented paradigm to a user-oriented paradigm as a conceptual orientation of, and approach to research and practice in the field (Dervin & Nilan, 1986). Dervin and Nilan characterise this shift by a set of assumptions underlying central concepts such as information, information users, information seeking behaviour and information utilisation. The user-oriented paradigm describes people as active information processors who interpret information and create sense or meaning in accordance with their unique model or image of the world; it

acknowledges that people's responsiveness to information is governed by a range of variables that are shaped by their immediate context; it considers peoples' information behaviours holistically, from the time their information needs are perceived to when they no longer exist; it acknowledges that what is going on inside people's mind will shape the way information is interpreted and utilised; and it recognises that qualitative approaches to research are consistent with this user-centred paradigm. This shift has contributed to a rich literature of user-centred studies investigating people's information needs and problems, information seeking behaviour, and the interactions between users and information professionals. This study acknowledges this paradigmatic shift, and assumptions of active information users, situationality, holistic view of experience, and internal cognitions underpin the research. Dervin (1991) however claims that while the field almost universally accepts the idea of "active, constructing, meaning-making human as fundamental to communication phenomena", she argues that in actuality, "we seem beset by a disciplinary schizophrenia" where we "talk about process ideas but rarely implement them methodologically" (Dervin, 1991: 61). She concludes that the field still retains a transmission metaphor and ignores for the most part "the constructions that are necessarily fundamental to the communicating process" (Dervin, 1991: 61). This study also acknowledges this methodological concern.

Secondly, this study has been informed by what has been called a cognitive perspective of information science. While the term "cognitive" has been applied to many different kinds of research and precise meaning has been lost, there is general acceptance that "cognitive" has to do with mental "objects" such as concepts, ideas and knowledge, and events that are not directly observable (Allen, 1991: 3). Rybash, Roodin & Hoyer define cognition as "the collection of processes that serves to transform, organise, select, retain and interpret information" (Rybash, Roodin & Hoyer, 1995: 92). According to De Mey, cognitive science deals specifically with what knowledge is and how it can be represented, and how it is transformed from one form to another. Its primary assumption is that any information processing "is mediated by a system of categories or concepts which for the information processor constitutes a representation or a model of his world" (De Mey, 1977: xvi-xvii; 1982: 4).

The cognitive viewpoint provides a metatheory about the individual as a seeker and interpreter of information, where information is defined as something that modifies an individual's knowledge, and where the study of information processes means studying the individual's mental processes. When applied to information science, the cognitive viewpoint explicitly considers that people's knowledge, beliefs, values, and attitudes, interact with information they receive, perceive or produce. The primary theoretical object of the cognitive viewpoint in information science is people's "structures of knowledge, or 'models of the world' located 'inside the mind of the organism'" (Belkin & Robertson, 1976: 203). This model of the world constitutes an individual's cognitive space which, consisting of highly dynamic and changeable cognitive structures, is seen to control the perception and processing of external information. This enables people to synthesise the meaning of information out of their own knowledge: "meaning is in the world view of the subject" (De Mey, 1982: 17). From this cognitive perspective, information is viewed as having the potential to transform what people already know into new knowledge. Wilson posits that the aim of the cognitive approach information science is to discover how people's knowledge structures and frames of reference "relate to the availability of information, how the choice of information is determined, and how the information may change the image, or otherwise affect a frame of reference" (Wilson, 1984: 200).

Since the 1970s, the cognitive viewpoint has provided a fertile ground for research and reflection in the field of information science. In a review of the literature of information needs and use studies from 1986-1989, Hewins (1990) concluded that research on people's cognitive processes has pursued two concerns. The first, and primary concern is related to determining how individual differences are being integrated into system interfaces design, particularly incorporating representations of knowledge into the design of computerised retrieval systems and expert systems. This research has sought to improve the transfer of information specifically by producing models of users' knowledge that are compatible with the conceptual frameworks used in information systems. According to Belkin, this has brought a focus on the interaction of people's knowledge, intentions, beliefs, and texts:

> "Taking the cognitive view has typically meant considering its scope as being concerned with some sort of human communication system, in which texts play a

key role, and of individuals within the system in their interaction with texts (or information), and with one another in relation to such texts" (Belkin, 1990: 12).

The second concern raised by Hewins is related to identifying what cognitive processes take place within people as they seek information, and how they utilise information. Hewins acknowledges that this concern remains an open issue. Other concerns such as learning, readibility, cognitive modelling and the criteria of users' evaluations of information sources are also being examined.

Allen's review (1991) of cognitive research in information science and its implications for system design supports Hewins' conclusions. Allen identifies that increasing attention is being given to world knowledge, system knowledge, task knowledge, domain knowledge, and cognitive processes such as thinking, imagining, remembering and problem solving in information-related behaviour, and particularly in relation to information retrieval. However, he concludes that researchers have "only begun to understand how some cognitive processes contribute to information-related behaviour" (Allen, 1991: 23), and that much more detailed study of cognitive processes is required before such knowledge can be incorporated into designing information systems, let alone improve the useability and effectiveness of these systems.

In essence, research based on the cognitive viewpoint has tended to focus on aspects such as information retrieval, interactions between generators, intermediaries and end-users of retrieval systems, and related classification and indexing issues. To some extent it has sidestepped what is the central concern of the cognitive viewpoint, that is, the internal cognitions of individuals as they process information. Heilprin would probably identify this focus still as part of the "Age of Information" rather than the "Age of the Mind". Research on the internal cognitions of individuals as they process information remains an important gap in the field. This gap is the focus of this study.

The third factor that has informed this study is somewhat more personal. It is an appreciation of the contribution made by Bertram Brookes to the emerging field of information science, and a belief that this contribution has yet to be fully explored. Today, with the perspective of two decades as hindsight, Brookes is regarded as one of the founders of information science. In 1947

he was appointed Lecturer in the Presentation of Technical Information in the Electrical Engineering department at University College of London, working mainly in such areas as communication, statistics, and the presentation of technical information. This, coupled with his strong interest in philosophy of science, determined the nature and direction of his contributions to the development of information science.

In 1966 Brookes transferred to the University College of London School of Librarianship and Archives in the post of Reader in Information Science, retiring from the College in 1977. Doubting if the term "science" was justified, he worked toward trying to help found the new science (Shaw, 1990: 3). At that time he was of the opinion that there was nothing that could be described as a science of information, and that there were no common assumptions, implicit or explicit, which could be regarded as its theoretical foundations. He claimed that information science was floating in "a philosophical limbo", and operated "busily on an ocean of commonsense practical applications which increasingly involve the computer. ... It has no theoretical foundations" (Brookes, 1980a: 125). His writings sought to "find the grounds of information science" (Brookes, 1980a: 126). In order to do so, he saw that a useful starting point was to acknowledge the fundamental problem of information science as "what is the nature of information?" (Brookes, 1974b: 44), and to attack this problem through the scientific method "by formulating general hypotheses which are capable of being tested, criticised, amended and refined" (Brookes, 1975a: 44).

Brookes was not alone in this pursuit, and similar concerns were being echoed in other parts of the globe at that time. For instance, Slamecka in an opinion paper to the Journal of the American Society for Information Science, urged the information research community to shift from a "preoccupation with document housekeeping and delivery mechanisms" to a focus on "the need to discover the principles of (and to develop means for) the optimal husbandry of one of man's key resources, knowledge" (Slamecka, 1975: 320).

Brookes recognised that the concepts of information and knowledge were central concepts in the emerging discourse of the cognitive viewpoint in information science. He considered that while the "practical" pursuit of information science was the collection and organisation of "the exosomatic

stores of knowledge which have an existence independent of those who created them" (Brookes, 1980a: 127), the "theoretical" pursuit of information science should be the interaction between the private, inaccessible thoughts and mental images of people, each unique, and the public documented artefacts of knowledge. He claimed that the phenomena of primary interest to information science should be "the cognitive interactions between users and the public knowledge systems organised for ease of user reference in libraries and data bases", rather than the objects of recorded knowledge (Brookes, 1980d: 248).

Brookes explicated this notion of "cognitive interactions" as an abstract "Fundamental Equation of information science", most commonly expressed in his writings as $K[S] + \Delta I = K[S + \Delta S]$ (Brookes, 1980a: 131). By this equation, Brookes was stating that in the process of doing something with information, a person's existing knowledge structure K[S] is changed by an increment of information ΔI, and this modification has some effect, a changed knowledge structure $K[S + \Delta S]$ where ΔS indicates the effect of the modification. He saw the equation as an interactive process of what people already know, how what they know changes through selectively taking in information, and the effect of these changes. Brookes also claimed that the Fundamental Equation could also be considered as a dynamic sequence, where each successive information input I_1, I_2 ... I_n in sequence changes the person's knowledge structure from $(S)_0$ to $(S)_1$, from $(S)_1$ to $(S)_2$ and so on, corresponding to the successive inputs:

$I_1 + (S)_0 \rightarrow (S)_1$
$I_2 + (S)_1 \rightarrow (S)_2$
$I_n + (S)_{n-1} \rightarrow (S)_n$
The overall sum of these sequences is:
$\Sigma I + (S)_0 \rightarrow (S)_n$ (Brookes, 1974: 148)

This equation, as an expression of the cognitive interaction of the mind and information, is firmly placed in Heilprin's "Age of the Mind" even though it predated Heilprin's notion by almost a decade. The equation provides a conceptual framework for the design of this study.

Brookes asserted that the analysis and interpretation of the Fundamental Equation was the central research task of information science, and claimed

there was a need for the field to investigate "experimental or observational knowledge structures and information inputs", observing what happens, measuring the effects as well as possible, investigating simple cases to develop skills in techniques and confidence in theories, then moving on to more complex cases (Brookes, 1975a: 48-49). However, he remained pessimistic about this endeavour, claiming that this problem had already attracted so many lines of research in neuro-physiology, robotics, and psychology that he doubted whether information science could find a foothold or that it could offer anything if it did" (Brookes, 1975a: 49). He also claimed that exploring humans' knowledge structures was both difficult and complex because these could not be observed directly, since their structural forms could be modified by the input questions applied to them to establish their form, nor was there an agreed technique for analysing their outputs. Brookes held this viewpoint for many years. Even in 1980, after some advances had been made in cognitive research in many disciplines, he still asserted that human cognitive processes were not accessible to "public observation at the level of detail required", and that there was "a long, long way to go before results applicable to the cognitive processes of individual users" were likely to emerge (Brookes, 1980d: 251).

Given the methodological difficulties of exploring people's minds, Brookes shifted his focus to knowledge recorded in documents and artefacts and how these stores of knowledge could be more effectively organised for intellectual access, claiming that such knowledge "presents a whole new world for us to explore" (Brookes: 1980a, 130). He thus turned his interest somewhat away from individual's cognitive processing of information, to examining collections of publicly recorded knowledge, claiming

> "we do not need to peer into other people's minds but only to study the interaction between humans and their exosomatic stores of knowledge. ... I would therefore define the objective of information science ... in terms of public, objective knowledge. ... The practical program is to organise mankind's untidy inheritance of exosomatic knowledge for more effective social use. ... I would redefine the scope of information science as the analysis, organisation, dissemination, and application of objective knowledge" (Brookes, 1974, 149, 152).

Brookes saw that these collections, stored mainly in libraries, archives and galleries, were not yet readily available to the information user because their

demands were at a more analytical level of organisation than libraries had to date attempted. He claimed that these knowledge structures, lying outside any single human mind, that is, "exosomatic", should be observed by anyone who wants to, and argued that "we need to learn how to build exosomatic knowledge structures, to learn how they grow and change" (Brookes, 1981b: 5). Later he developed a theory and calculus for doing this (Brookes, 1980b: 209-221; 1980c: 269-275; 1981a: 3-12). Brookes also claimed that understanding these exosomatic knowledge structures was an important first step to discovering more about people's internal knowledge structures.

In summary, Brookes' equation can be viewed as a conceptualisation of the fundamental transformation that characterises information and its effects in the mind. It is an expression of what happens in the mind when people are exposed to information and do something with this information. In this sense, the equation can be regarded as an expression of cognitive information utilisation. Yet in the context of both a user-oriented paradigm and a cognitive viewpoint of information science, exploring what happens in people's minds when they are exposed to information, within the framework of Brookes' Fundamental Equation, remains as an open challenge. This study can be seen as a response to this challenge.

In saying that exploring what happens in people's minds when they are exposed to information can be done after all does not down play the wisdom and scholarship of Brookes in making his original assessment of the difficulties. In the twenty years since Brookes first presented his Fundamental Equation however, significant advances have been made in the fields of cognitive psychology, artificial intelligence, knowledge representation and information science that have made important theoretical and methodological contributions to exploring cognitive information utilisation. This study is informed by, and hopes to build on these contributions, as documented in Chapter 2 and Chapter 3.

1.2 AIMS OF THE STUDY

The specific purpose of this study is to further our understanding of cognitive information utilisation, employing Brookes' Fundamental Equation as a general framework for establishing research questions, operationalisations and procedures. The study seeks to examine what people do cognitively with

information, how it changes what they know, and what are the cognitive effects. While it is acknowledged that information has the potential to change, how it changes is less understood. Specifically, the study is concerned with *how a person's knowledge structure is modified by exposures to information, and what are the effects of this modification.*

A substantial literature has been written on information utilisation, yet as shown in the literature review in Chapter 2, there are major gaps in our understanding, particularly in relation to the cognitive aspects of information utilisation. This area of information utilisation research has traditionally been presented as problematic because it involves investigating what happens in the mind resulting from the mind doing something with information. It is both the study of cognitive information utilisation, acknowledged as a challenging arena of research, and its conceptual framework of Brookes' Fundamental, Equation that make this study unique.

"Knowledge structures" and "effect" are central concepts in the study. As indicated above, the equation states that in the cognitive process of doing something with information, a person's existing knowledge structure K[S] is modified by an increment of information ΔI, resulting in a changed knowledge structure $K[S + \Delta S]$ and where ΔS is the effect of the information. According to Brookes, the changed knowledge structure is a function of the properties of the existing knowledge structure and new information, and continually evolves by the accretion, integration and adjustment of many increments of information (Brookes, 1980d: 254). This continually evolving process is to some cognitive effect.

Brookes presented the equation, not as a mathematical formula, but as a general expression of the interaction of information and knowledge. He did not explicate the symbols of the equation in any great detail. However, in his writing he appeared to use the term "effects" in two ways. Firstly, and in a general sense, he said there is an effect on people's knowledge structures when they do something with information. He stated this whole effect as $K[S + \Delta S]$. Secondly and more specifically, a changed knowledge structure K[S] is one specific effect, and ΔS is another effect. Thus it could be reasoned that investigating this part of the equation $K[S + \Delta S]$ might provide two potential sets of indicators of information utilisation, these being changes in people's knowledge structures K[S], and the cognitive effects of the

modification ΔS. In the absence of any explanation or elaboration of what these cognitive effects might be, this study has interpreted ΔS in terms of people's perceptions and descriptions of what they have been able to do cognitively with the information. This interpretation is felt to be consistent with the user-centred orientation and the cognitive viewpoint that has shaped this research. The use of the brackets [ ] in the equation suggests that the changes to knowledge structure and effects together are integral parts of people doing something with information. The brackets also suggest that there is some association between the changed knowledge structures and the perceived effects. This interpretation has shaped the specific research problems to be addressed in this study.

Thus, using Brookes' Fundamental Equation as a conceptual framework for examining cognitive information utilisation, and a small group of girls in their final year of secondary education, the study sought to:

(a) *establish the effects ΔS of exposure to information perceived by the girls;*

(b) *establish how the perceived effects are associated with changes to their knowledge structures K[S];*

and, on the basis of (a) and (b)

(c) *establish the patterns, if any, within and between the girls in relation to changes in knowledge structures and perceived effects K[S + ΔS].*

Given the absence of a priori generalisations on which to base the study, as established in Chapter 2, it was considered inappropriate to formulate hypotheses for testing. Rather, the study has focused on developing constructs of cognitive information utilisation through an investigation of how information exposures modify people's knowledge structures, and the perceived effects of those exposures.

1.3 SIGNIFICANCE AND BENEFITS OF THE STUDY

This study contributes to the theoretical foundations of cognitive information utilisation and to human information processing. Intuitively and in information practice it seems to be accepted as a fact that information makes a difference

to what people already know; that it has some effect. It is the very reason for the multitude of information agencies and information services; it underpins education systems; it is the basis of media services such as radio and television, as well as advertising, and publicity campaigns. This study goes beyond the common sense descriptions of the effects of information to understanding the cognitive processes and cognitive effects of exposure to information at a more abstract level, and from the perspective of the individual. Little is understood about the specifics of this notion, particularly about the dynamic, active role of knowledge structures, effects of information exposure, and cognitive information processing as dimensions of information utilisation. Rich claims that most utilisation research does not go beyond primitive distinctions of types of information utilisation, and is so broad that it "camouflages the complex interactions that produce a ... decision" (Rich, 199: 325). This study is an in-depth study, seeking to establish and elaborate concepts of cognitive information utilisation. Its approach is what Blumer refers to as "lifting of the veils" by "getting close to the area and digging deep into it through careful study" (Blumer, 1977: 38). In doing so, this research contributes to the theoretical foundations of cognitive information utilisation and to human information processing by establishing constructs of cognitive information utilisation.

This study, with its focus on internal cognitions, makes a significant contribution a more holistic understanding of human information seeking behaviour. The identification of user characteristics has been considered an important aspect of information science in recent years. Numerous studies highlight the importance of modelling the information behaviours of groups in order to gain insights that can contribute to measurable improvements in the provision of service. Categories of variables important in shaping information behaviour that have been identified in research include demographic characteristics, status, goals and backgrounds of users, their situations, and their levels of knowledge of both the topic and the information retrieval system. However Lantz (1984) and Vickery & Vickery (1987) argue that our understanding of human information situations and behaviours with regard to external contextual factors will take on a more holistic perspective through the complementary study of personal knowledge structures and cognitive information processing, particularly from a context-bound holistic perspective. In a similar vein, Ingwersen identifies the need of information science to deal with the psychological and linguistic factors underlying information

processing and knowledge creation in more depth, commenting that "much more interest has been devoted to the organization of different document entities brought together, ie., to systematize the conceptual knowledge structures embedded in the entities in libraries, for instance" (Ingwersen, 1984a: 85).

Modelling of information processes and the effects of information exposure are seen as critical to making the design and development of information systems more responsive to people. Hewins claims: "We must determine how the acquisition of information or knowledge changes the user's perception of his / her world and how it changes behavior as a result if we are to design dynamic, adaptive systems" (Hewins, 1990, 165). Considerable attention has been given in recent years to the development of computer information technology that simulates the neural communications of the human brain, yet it is recognised that the development of such technology as dynamic, adaptive systems, and for people to interface with such systems, requires indepth understanding of what actually happens in people's minds. Indeed, Borgman (1986) asserts that the most promising theoretical areas to be explored in relation to human-computer interaction are the nature of cognitive information processes people bring to the interaction. Similarly, Gaines (1987) considers that the development of commercial applications of expert systems is being impeded by a knowledge-engineering bottleneck focusing on lack of understanding of the underlying processes of knowledge acquisition, transfer and utilisation. In response to these concerns, an understanding of cognitive effects has the potential to form the basis of an alternative set of categories or desired outcomes which can be built into computer information systems as a design feature, providing another set of options that allow users to enter and interrogate a system on the basis of desired cognitive effects, rather than just in terms of content. For users, this would not only contribute to enhanced browsing, grouping, connecting and interpreting information, but also provide greater intellectual accessibility, and time-cost benefits in meeting their particular information needs.

At a broader level, an understanding of cognitive information utilisation can inform the organisation, classification and indexing of information for information retrieval. Traditionally indexing and classification schemes for information provision have not been constructed on an understanding of people's information behaviours and cognitions, rather they have been

developed by experts to facilitate organisational requirements and goals, and reflect experts' conceptualisations of knowledge and how this knowledge is related. Brookes also acknowledged that the development of a sophisticated theoretical model of cognitive information processes would make a contribution to the continued development and operation of information systems, and that essential to this was the clarification of the relationships between information, knowledge and action. He recognised that such a focus would have a wide ranging impact on many aspects of information provision, for example, on conventional indexing techniques. He illustrated this specific impact by saying that we would no longer ask "what is this paper about?", but rather "what does this paper add to or how does it change what is already known?" (Brookes, 1981a: 5).

A potential benefit of this study is seen in the area of information consolidation, that is, the restructuring and repackaging of information to meet the information needs of individuals and groups, based on an understanding of the information need and behaviours of the group (Saracevic & Wood, 1981). By understanding how information is utilised cognitively, teachers, for example, should be able to more effectively design learning activities to ensure that the most effective learning can take place, and that desired cognitive outcomes are achieved. Understanding how young people cognitively work with information may assist government agencies, media organisations and community information providers to select and package information more appropriately to these audiences to ensure greater receptivity. For example, despite media publicity and education programmes, the use of legal and illegal drugs continues to increase in Australia. Understanding how young people process such information may contribute to the development of more effective programmes to target this increase. Echoing these ideas, Zaltman considers that the greater the information about a user's knowledge and value system as it relates to knowledge acquisition, the greater the ability of policy analysts and other change agents to develop knowledge in ways compatible with that value system (Zaltman, 1979).

This study also contributes to methodological advancement in the field. Given the acknowledged difficulties of developing measures to observe human information processes and measuring information and knowledge in human terms, this study develops, justifies and implements a methodology for

investigating this complex area. This methodology has been built on an understanding of existing conceptual and methodological advances in cognitive science, knowledge representation and information science. The methodology is shown to be workable, and provides an important starting point for further methodological developments in this area.

In summary, this study provides a deeper understanding of cognitive information utilisation as a theoretical construct of information science, and contributes to the development of research in an area that is the heart of information science and where there is paucity of research. In doing so, this study contributes to the development of a research methodology from the perspective of information science for examining cognitive information utilisation. The development of such a tool should enable researchers to further empirically develop this important field. In addition, it provides an approach to enhancing information systems design to facilitate more effective access to information, as well as to information providers in restructuring and repackaging information more effectively for user groups.

1.4 TERMINOLOGY AND GLOSSARY

This section presents definitions of key terms in the study. These definitions are addressed in more depth in the following chapters. Terminology is based on Australian literary conventions, except in direct quotations where the spelling of the authors is used, for example "utilisation" and "utilization".

concept:
A concept is a word or phrase that is used to categorise and label a group of people, things, events or ideas. It is a mental summary of a category. It is based on a set of features associated with a conceptual unit and is definitional in nature (Soltis, 1978).

exposure to information:
Exposure to information is the act of disseminating messages; it is giving information in the hope that it will be read and thoughtfully considered. In this study, the girls were exposed to information by being given specified information at particular times in the research procedure, and were requested to read and reflect on this information.

information:

In this study, information is publicly recorded knowledge in a permanent form which is accessible to others. It is derived from ideas provided by Otten (1974), who suggested that individual subjective knowledge, the product of cognitive processes, may be transformed into objective knowledge by some form of public expression. This information is publicly observable, is generally stored in some location, is transportable, and may be altered in various ways. For the purposes of this study, the girls were given a set of printed papers which contained messages about the drug heroin.

information utilisation:

Information utilisation focuses on what people in a range of contexts do with information that they seek out or have provided to them. The study of information utilisation as "doing" has focused particularly on two dimensions: (1) action, a behavioural "doing", and (2) thinking, a cognitive "doing". Underpinning this focus is the assumption that information has the potential to influence, to make a difference to the thoughts, actions and emotions of people.

In this study, information utilisation is defined as people doing something cognitively with information. Cognitive information utilisation focuses on what happens in people's minds when they do something with information that is made available to them, as opposed to external, observable behaviours and actions. It is operationalised as the girls' perceived cognitive effects of exposures to information and as the changes to their existing knowledge structures after the exposures to information.

knowledge:

In this study, knowledge is the sum total of all the ideas that a person has in his or her mind. It is operationalised as the total of the written and verbal statements made by a girl about the drug heroin.

knowledge representation:

Knowledge representation refers to portraying the state of knowledge of a person in ways that allow conclusions about what is being modelled to be drawn through the examination of the representations.

knowledge structures:

Knowledge structures refer to the internal, private knowing of a person organised as a coherent, interrelated entity. In this study, it is operationalised as a graphical representation called a conceptual graph structure. It consists of self-contained units called statement nodes, which are interrelated by a network of relational arcs. Specifically, the nodes consist of propositions about the drug heroin and these are linked together by some relation. A change in knowledge structure is defined as an alteration to the existing arrangement of nodes and relations.

proposition:

A proposition is a unit of knowledge that expresses a complete thought. In this study, a proposition is operationalised as a sentence or string of words that contain at least two concepts about the drug heroin linked together to form a meaningful unit expressed in the girls' natural language.

CHAPTER 2

CONTEXT AND FRAMEWORK FOR THE STUDY

2.1 INTRODUCTION

This chapter outlines the context and framework for the study and provides an overview of the relevant theoretical and empirical literature. The chapter is divided into two parts. The first part examines relevant aspects of the concept of information utilisation as the immediate focus of the study. The scope of this review is selective rather than comprehensive, drawing primarily on the knowledge utilisation and information user behaviour literatures. The second part examines the premise that Brookes' Fundamental Equation $K[S] + \Delta I = K[S + \Delta S]$ is an expression of cognitive information utilisation, and discusses the components of the equation as the framework for the design of the research. Brookes' Fundamental Equation brings together central concepts of cognitive information utilisation. These are information, knowledge, knowledge structures, and effects. The specific sequence of this chapter is as follows:

PART 1 OVERVIEW OF INFORMATION UTILISATION

- The study of information utilisation: terminology and definitions **Section 2.2**
- Perspectives of information utilisation **Section 2.3**
- Classification of information utilisation **Section 2.4**
- Contextual factors shaping information utilisation **Section 2.5**
- The current state of information utilisation research **Section 2.6**
- Research approaches **Section 2.7**
- Summary and implications for the study **Section 2.8**

PART 2 BROOKES AND THE CENTRAL CONCEPTS OF INFORMATION UTILISATION

2.2 THE STUDY OF INFORMATION UTILISATION

The study of information utilisation is an active area of academic inquiry at both a basic and applied research level. It is embedded in several different traditions. It is informed by research and critical reflection in history and philosophy of science, sociology of knowledge and applied social science research, technology transfer, innovation diffusion, organisational change, interpersonal and mass communication, policy research, information user behaviour, behavioural theory, and cognitive science. These multiple theoretic perspectives have generated substantive terminological inconsistency and confusion, definitional problems, diverse methodological approaches, conflicting findings and empirical generalisations. The widely varying linguistic uses of the term and competing conceptions also make it difficult to identify extant works, let alone compare, contrast and evaluate essential variations in concepts, methods, measures and findings. Yet some analysis of the diversity is important to establishing directions, parameters and underpinning assumptions of this research.

2.2.1 Terminological confusion

At the outset, there are many labels to identify the central concept of the area of study. These include "information use", "knowledge use", "information utilisation", and "knowledge utilisation". These terms are often employed interchangeably, and generally with little clarification of meaning. For example, Dunn, in making the statement "knowledge (or information) use"

(Dunn, 1983a: 120) appears to use the terms "information" and "knowledge" interchangeably. Lantz (1984) in a study of barriers to effective utilisation of information, uses the terms "knowledge" and "information", and "use" and "utilization" interchangeably. Levitan & Hughes (1981) frame their discussion in terms of utilisation of "research information", although others cite this work in the context of "knowledge utilisation". Larsen (1985) employs the terms "use" and "utilisation" interchangeably, despite her earlier claim that "one of the most urgent needs is the formulation of a common set of definitions, providing sufficient standardization of terms and concepts to allow for comparison of research and data" (Larsen, 1980: 435). This lack of consistency and clarification of terminology has perpetuated for many years, and continues to the present time. A recent example illustrates this. In a study of professionals involved in child welfare services by Hutchinson (1995), the terms "information" and "knowledge" are undefined and used interchangeably, as are the terms "use" and "utilization".

In a review of the literature on the concept of information utilisation, Karapin, while faithful to the particular conventions of each author, elsewhere claims: "I use the words interchangeably for the sake of variety". He further notes that

> "'utilization' contains eight more letters and four more syllables than 'use', and means almost exactly the same thing. Its extra bulk may lend 'utilization' a kind of scientific authority. At any rate, most of the writers reviewed here use the longer word, particularly those trying to develop a more precise, technical definition" (Karapin, 1986: 261)

Authors tend to simply state that they are investigating knowledge and/or information utilisation, and provide no further clarification, assuming that the reader does understand what is meant. In some literature, terms such as adaptation, reinvention, co-optation, dissemination, diffusion and modification have also been used to characterise utilisation. Terminological confusion is further served by the discussion of ideas such as non-utilisation, under utilisation, premature utilisation, over utilisation, misutilisation, and disavowal (Deshpande & Kohli, 1989) without addressing ambiguities and overlaps.

A case in point is the study by Slappendel (1994). This study looked at processes by which ergonomic knowledge was introduced into design and development processes in organisations, and the role of internal and external

contextual factors that shaped this. Slappendel concluded that terms such as "adoption" and "utilisation" failed to capture adequately the underlying processes, and substituted the term "development of capability" to describe how an organisation embraced externally generated theoretical knowledge and firm-specific practical knowledge (Slappendel, 1994: 204).

For the sake of consistency, the term "utilisation" will be used throughout this research. The term "information" will also be used, notwithstanding the significant and complex information - knowledge debate that is important in the context of information science in which this study is situated, and in understanding Brookes' Fundamental Equation. This is clarified in Part 2 of this chapter.

2.2.2 Definitions of information utilisation

The question of what constitutes utilisation has been one of the most salient issues in the field. Buchmann argues that the problem of knowledge or information utilisation is at first a conceptual problem. She asks

> "What are people who connect knowledge and utility doing? Why do they pair off knowledge with utilization? What practical or conceptual problems does the connection of knowledge and utility appear to solve?" (Buchmann, 1985: 154)

She claims that while being grounded in common sense, the connection of knowledge and utility, which often includes the notion that the value of knowledge is synonymous with its utility, misses many of the points of acting and thinking. She argues that knowledge utilisation erodes bases for good practice and encourages people to take knowledge as more certain and directly relevant to action than it is. The concept of knowledge utilisation construes knowledge in terms of utility and draws on the metaphor of knowledge as a tool. Connecting knowledge and utility assumes that knowledge must be used to be of value, and that utilising it connotes dispositions and actions seen as praiseworthy, sensible and down to earth. She further claims:

> "The expectation is that something good will come of this, exceeding purposes of knowing or understanding." (Buchmann, 1985: 156) ... The tentativeness of knowledge is a safety catch that a pretension to usefulness tends to remove.

> The problematic concept of knowledge utilization defeats not only the purposes of knowing, but the purposes of action as well, for it overestimates the certainty of knowledge and underestimates the range of valid practical concerns" (Buchmann, 1985: 166).

In her analysis, Buchmann identifies a number of assumptions that have shaped information utilisation research over many years. These include the idea that knowledge, in being made available, has value and practical utility; and that information utilisation goes beyond knowing and understanding to action. These assumptions have clearly shaped how utilisation is defined in the field.

A diverse range of definitions of utilisation is provided in the literature. For example, Booth defines utilisation narrowly as "the direct application of research to a pending decision in such a way that it makes a difference to what happens (Booth, 1990: 81). In contrast, Backer & Shaperman claim that utilisation covers "a full spectrum from dissemination of information to more active strategies aimed at promoting the actual adoption ... of innovative programs or technologies in new settings" (Backer & Shaperman, 1993: 387). Berg & Theadbo refer to "consumption of information" (Berg & Theadbo, 1981: 183), Dervin & Nilan refer to the ways in which information "helps" (Dervin & Nilan, 1986: 21), while Cook & Pollard refer to "the serious discussion of results in debates about a particular project or programs" (Cook & Pollard, 1977: 161).

The literature as a whole conveys the sense that information utilisation is all about people and information coming together; it is about people "doing something" with information that they have sought and gathered themselves, or that is provided for them by someone else. This is supported by the definition established by Beyer & Trice on the basis of their review of application of research results: "Utilization of research results entails people doing something with research results. What they do in using research can include a wide or narrow range of diverse behaviors over short or long periods of time" (Beyer & Trice, 1982: 595; underlining added by the author of this thesis). From the perspective of the user, Taylor defines "uses of information" as "what information does to or for the recipient and for his or her problem or situation" (Taylor, 1991: 221). The definitions cited above also highlight the dichotomy of "doing" as an end result, and as a process. This

distinction is shown in Machlup's definition. Machlup claimed that to "use" information "is to listen, to look at, to read; in short, it is its reception and, if possible, the full or partial understanding by the recipient. The use of the knowledge is something else. The act of delivering is one thing. The object delivered is another ... it seems more reasonable to me to keep use and effect of use separate" (Machlup, 1979: 63, 64). Machlup has distinguished between doing something cognitively with the information, and doing something with the end product, what he calls knowledge. The nature of what is actually done, and how it is done, however, is a central issue and open to considerable variation.

In essence, information utilisation focuses on what people in a range of contexts do with information that they seek out or have provided to them. It has two dimensions: (1) action, a behavioural "doing", and (2) thinking, a cognitive "doing". Underpinning this focus is the assumption that information has the potential to influence, to make a difference to the thoughts, actions and emotions of people. In this study, information utilisation is defined as people doing something cognitively with information. Cognitive information utilisation focuses on what happens in people's minds when they do something with information that is made available to them, as opposed to external, observable behaviours and actions.

2.3 PERSPECTIVES OF INFORMATION UTILISATION

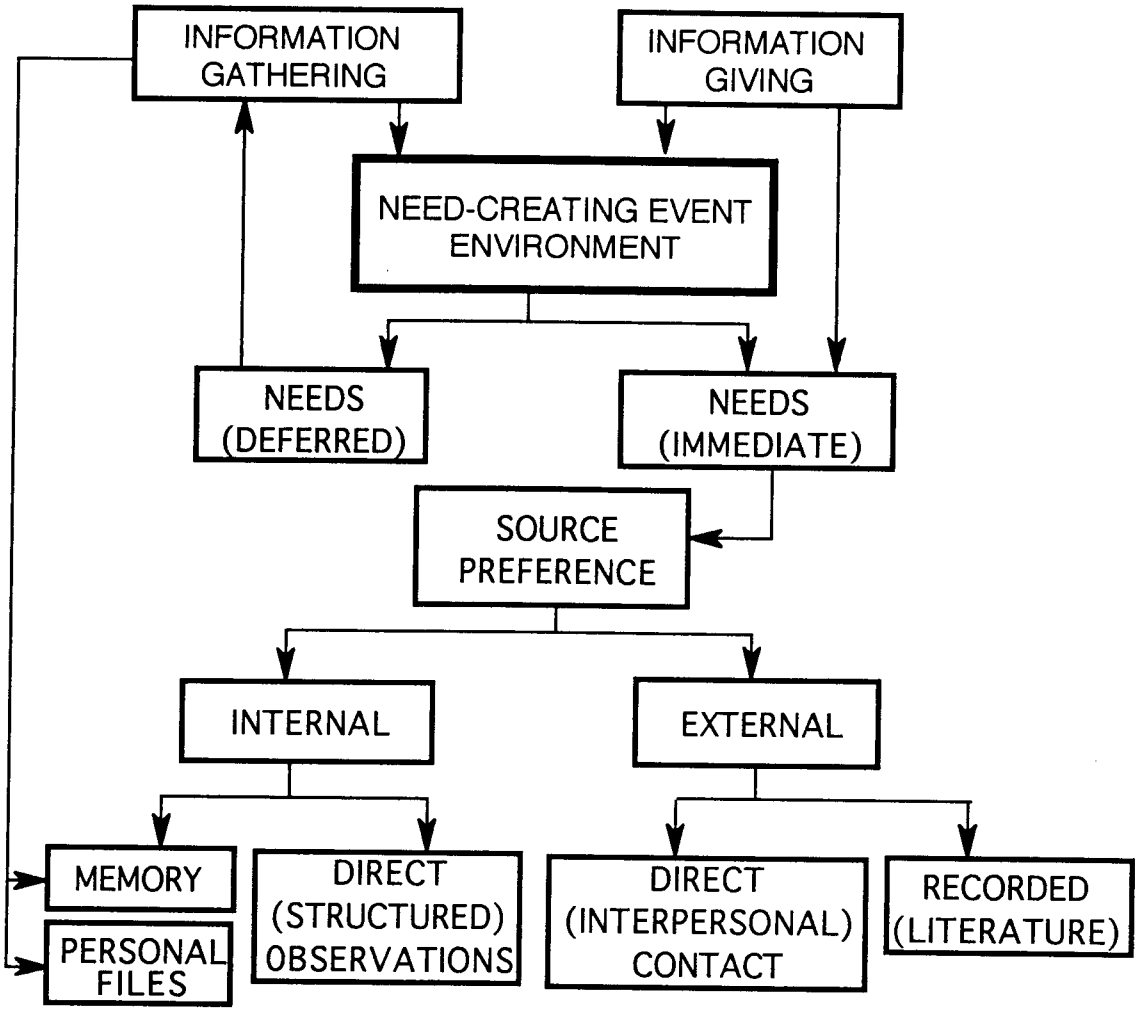
Against the diversity of terminology and definitions, there appears to be two dominant perspectives of information utilisation in the literature. On one hand, the study of information utilisation is placed largely in an organisational or systems context, with particular emphasis given to the direct transfer of social science research findings. In 1990, Backer estimated that the literature base on utilisation of research findings alone contained more than 10,000 studies, and a review of a number of citation indexes would suggest some growth in the five years since that time. An important contribution to this literature has been made by the journal *Knowledge: Creation, Diffusion, Utilization* which began publication in 1979, and since September 1994 is known as *Science Communication: An Interdisciplinary Social Science Journal*. In this context, information utilisation has been largely conceptualised as "acting" - a "behavioural doing", with particular attention given to the types of organisational change, end-states, external behaviours,

actions and outcomes. "Knowledge utilisation" tends to be the predominant label in this perspective.

On the other hand, the shift in the last two decades from a system-oriented paradigm to a user-oriented paradigm in information science has also seen greater emphasis in that literature being placed on the study of information utilisation in a wider context of the everyday information needs and information seeking behaviours of individuals, and from the perspective of the individuals. In this user-centred paradigm, information utilisation is conceptualised more holistically as an interactive change process, with attention given to the process of "thinking" - a cognitive "doing", rather than the direct transfer of information to bring on desired outcomes and end-states.

The emergence of this trend can be illustrated clearly by comparing one of the early models of information behaviour presented in the information science literature with that of a more recent model. Figure 1 is a model of information seeking behaviour by Krikelas (1983: 17). The model shows the scope and inter-relationships of key concepts of information seeking behaviour, based on an analysis of a cross-section of library and information science literature up to 1983. It highlights the selection of information from a range of sources in response to a need-creating event. The model however does not show people actively doing something with the sources selected, and it does not show the potential for decisions and actions as outcomes of the selection of information. It does not make any links back to the person's need-creating event or environment to indicate that through processing the selected information and taking some kind of cognitive or behavioural action on it, the need is resolved. In essence, the model seems to imply the direct transfer of this information to the immediate need in order to resolve that need.

FIGURE 1
MODEL OF INFORMATION-SEEKING BEHAVIOUR: KRIKELAS



(Krikelas, 1983: 17)

Green's model (1991: 136) shows a different perspective of information utilisation to that of Krikelas. In a linguistic analysis of a random sample of library and information science abstracts, Green sought to determine what cognitive models of information and the information transfer process were most commonly held. She identified three models, two of which were designated as systems-oriented models: a *direct communication* model that focuses on the channel between the information source and the information user; and an *indirect communication* model that elaborates the information system's function as a vast store of information to be accessed by users. The dimensions of the third model, an *information-seeking* model, are shown in Figure 2.

FIGURE 2
INFORMATION-SEEKING MODEL: GREEN

1a. The information seeker experiences information needs.
1b. Information needs exist within the information seeker's internal ideas space as gaps between constructs.
1c. Information needs exist within the information seeker's internal ideas space as a degree of emptiness within a container.
2a. The information seeker desires information.
2b. Information is desired for its relevance to the information need.
2c. Information is desire for its (a) intrinsic worth, (b) value, (c) accuracy, and (d) timeliness are emphasised.
3a. The information seeker searches for information.
3b. The information seeker locates the information.
3c. The information seeker selects specific information.
3d. The information seeker retrieves information.
4. The information seeker processes the information.
5a. The information need is satisfied. Utility of information is emphasised.
5b. Information is used to build a bridge across a need gap. Structural qualities of information are emphasised.
5c. Information is used to fill the need container. Quantity of information is emphasised.

(Green, 1991: 136)

This model presents the notion of information utilisation as an interactive process, expressed in components 5a, 5b and 5c. Terms such as "processes", "utility" and "is used" presents users who are actively and purposefully engaged in doing something with the retrieved information to satisfy their perceived information needs. However, Green acknowledges that understanding how information is utilised by humans is still under-represented in the literature and research agenda of the field, and claims that it is particularly crucial to comprehend what happens when a human being interacts with recorded knowledge and experiences a change of cognitive understanding. She identifies specific shortcomings in relation to "the cognitive structures of texts; and how readers perceive them, re-mould them, and integrate them with the cognitive models they possess at the outset of the interaction" (Green, 1991: 142). These shortcomings, expressed in terms of cognitive "doing", reflect the notion of information utilisation expressed in Brookes' Fundamental Equation.

The two perspectives of information utilisation identified above have been shaped by the kind of questions that researchers have asked, and by the research methodologies employed to answer the questions. A closer

analysis of these perspectives establishes the conceptual gap that is the focus of this research, and provides directions methodologically for investigating this gap.

According to Rich, the study of information utilisation have tended to focus on the following types of questions:

- to what specific uses is information put in organisational decision making?
- what types of information are selected and what are ignored?
- how do research findings contribute to the decision-making process?
- what are the diffusion and dissemination patterns of information from the time it enters into an organisation?
- to what extent does information influence in organisations?
- what is the rate of information adoption?
- what are the characteristics of social science research that make it useful to decision making?
- to what extent does information benefit the decision maker or decision making process?
- to what extent can one document levels of premature utilisation, deliberate non-utilisation and / or selective utilisation of information? (Rich, 1991: 328)

These questions primarily revolve around how the findings of social science research impact on organisational decision making, and are oriented to establishing the organisational consequences of knowledge creation and utilisation, and identifying the factors affecting the implementation, takeup, and practical applications of knowledge (Zhang, 1989). The predominance of these questions has given rise to focus on types of organisational change, end-states, external behaviours, actions and outcomes.

Rich (1991) acknowledges that these questions give little attention to the cognitive interactions of people and information, despite earlier calls for such attention. For example, some years prior to Rich's review, Fine (1984) suggested that the field needed to ask the following questions:

- what is information?
- how do people tap the internalised information they already have?

- how is new information integrated with existing knowledge within the individual?
- how is information acknowledged as information by the individual?
- how does the unconscious processing of information take place? Is it immediate, or does it require time and distance?
- how does the person's psychological state open up or inhibit the way information is received and processed? (Fine, 1984: 446-447)

Greater consideration of these questions in recent years has contributed to the emergence of the perspective of information utilisation as an interactive process. Both sets of questions identify the different perspectives of information utilisation that have developed over a 25 year period: information utilisation as "acting" - a behavioural "doing", and "thinking" - a cognitive "doing". These perspectives, described by this researcher as "end-state" and "interactive change process" are discussed in the following section.

2.3.1 Information utilisation as end-state

In the main, the focus of information utilisation as end-state is on the impact of recorded technical and professional working knowledge, science and social science-based expertise and research by groups of people in settings of public policy, organisations and professional practice. Such end-states are concrete, overt, tangible, perceptible to the people involved, and open to direct and objective observation and measurement by others (Patton et al, 1977; Holzner & Fisher, 1979; Levitan & Hughes, 1981; Booth, 1990). It is primarily reflected in studies which have investigated the translation of social science knowledge into guidelines for the improvement of practice, chiefly though not entirely, organisational practice. For instance, some of the early information utilisation studies of the 1930s focused on how farmers utilised research information. The aim of this body of research has been to establish the nature of adoption, application and institutionalisation of this information in terms of the specific decisions or measures that result from its application. From this perspective, information utilisation is seen to begin after the information is produced or created, and information is said to be utilised when it is implemented as part of a program or directly leads to some specific decision or specific course of action. The end-states are the evidence of information utilisation.

In this end-state conception of information utilisation, change is seen to take place as a linear process. This conception of information utilisation does not deny the notion of process. While it is acknowledged that information has to be understood before it could be translated into action, the focus is not on the process, but on the actions as observable behaviours. This has tended to embed the predominance of a direct application view, albeit simplistic, of information utilisation as a discrete, straightforward, action-oriented activity where information is translated directly into action, and where the entire set of recommendations, often derived from utilisation research is adopted intact, in the form suggested by the researcher.

Underpinning this conception of information utilisation are the assumptions that the information is relevant and will improve wisdom of decisions, and that utilisation should result from presentation of information. Indeed, a recurring assumption is that utilisation in any situation means the complete organisational adoption of information, and the inherent belief that utilisation, not nonutilisation, should result from the presentation of information. Utilisation is thought to be desirable and nonutilisation to be unfortunate. In recent years these assumptions have been more vigorously challenged, with questions being asked as to why this impact is in reality generally quite low. This has generated some studies of information utilisation which have been motivated by non-use of research results that were perceived to have high utility (Wingens, 1990; Rich, 1991).

Wingens (1990) for instance claims that the so-called two-communities theory, evolved by Snow in the 1950s to describe differences between the natural sciences and the humanities, is often the basis for speculating on why information produced by social scientists has produced little impact. Nonuse is attributed to the different cultures or life-forms and their different values, reward systems and languages that scientists and policy makers share respectively. Wingens considers that the two-communities metaphor gives at best a theoretical explanation of nonuse, and this is very different to a theoretical description and explanation of successfully actually realised information utilisation.

2.3.2 Information utilisation as interactive change process

More recently in the literature there is also the portrayal of information utilisation as a complex evolutionary and interactive process of which tangible and observable end-states are the last phase. This more holistic view of information utilisation firmly embeds the notions of cognitive change and behavioural change as central concepts, and makes the distinction between "utilisation" as doing something with information and making a difference to the thoughts and actions of people, and "impact", seen as modifications in a programme or policy, and "utility", referring to the relevance of the information (primarily research findings) to an area of policy or programme.

In an early review of empirical studies, Beyer & Trice (1982) conceptualised information utilisation as a process consisting of four interacting components: cognitions, feelings, choices and actions. According to Beyer & Trice, cognitions defined which elements of situations people saw as relevant to them; feelings expressed the values that people placed on alternatives; choices integrated cognitions and feelings by expressing a selection between alternatives; and actions were the overt behaviours people engaged in to implement conscious or unconscious choices. These components established people as active, selective, constructive and reflective agents in utilising information. Information utilisation as interactive change implies a process of exposure, selection, adaptation, reinvention and modification of information to fit people's needs and situations. It involves cognitive and affective processes, and cognitive actions, as well as overt, observable behaviours and actions (Weiss, 1979; Holzner & Fisher, 1979; Karapin, 1986; Backer & Shaperman, 1993).

Rich (1991) also presents information utilisation as an interactive process, a series of "less than discrete" events, which may or may not lead to a specific action by a particular actor at a given point in time. He elaborates further the cognitions component of Beyer & Trice's view. He sees information utilisation as embracing a number of generic stages which occur "within an individual's head". He states that information utilisation is initiated or "triggered" by information "pickup", that is, the "process by which information is retrieved or received by a given user". Information "processing" involves understanding the information, testing it using cognitive procedures against personal

intuition and assumptions, testing it for reliability and validity, and transforming it into a form that is preferred by an individual user. Once information is received and processed, it may or may not be applied by a given user. Application involves the decision whether to take action on the available information (Rich, 1991: 328-30). Rich's notion of information utilisation is expressed concisely by Hutchinson as "a synthetic process [that] is contextually and temporally dependent" (Hutchinson, 1995: 103). Rich further asserts that the field needs to look beyond application, impact and action of information to the cognitive processes in order to more fully understand information utilisation.

Kennedy's study (1983) is an example of conceptualising information utilisation as an interactive change process involving internal cognitions and external behaviours. This study sought to identify how policy makers and program managers of school districts incorporated new research or evaluation findings into their personal, working knowledge, and how these two structures of knowledge (existing knowledge and research findings) influenced one another. Kennedy identified three distinct, though interdependent processes involved in dealing with evidence, and collectively labelled these processes as "encorporation". The first process identified was that of seeking out new evidence and mentally attending to it; the second was that of incorporating it into existing working knowledge, and the third was that of applying it into working situations as they arose. These active, continual and largely unsytematic processes were all seen to contribute to the ongoing evolution of thought and action.

This perspective of information utilisation also finds some support from the sense-making theory developed by Dervin. She claims this theory is a set of assumptions about the nature of information, the nature of human use of information, and the nature of human communicating (Dervin, 1989). According to Dervin, sense-making is a process, and sense is the product of that process. The major concepts in the theory are "situation", "gap", and "uses/helps". Of particular relevance to this study is "uses/helps", conceptualised in terms of putting information to work, that is, how the individual is helped, facilitated, or sometimes impeded by the information. A constructivist stance underpins this view of information use. Dervin does not see information as something that exists apart from human behavioural activity. All information is a personal construction, and information use is

posited as a "constructing" activity, that is, "the successive modifications of internal pictures of reality, a series of constructings and reconstructings (Dervin, 1983a: 5). These modifications are thus the steps people take to construct sense out of their worlds, the process through which individuals inform themselves. Consistent with the constructing activity, Dervin's uses/helps are conceptualised as verbs, rather than nouns. This view, as with the other interpretations of information utilisation as interactive change process, gives precedence to the individual, to cognitions, and to the importance of making things happen and moving forward.

2.4 CLASSIFICATION OF INFORMATION UTILISATION

The empirical investigation and measurement of information utilisation has produced the classification of conceptual, instrumental and symbolic utilisation (Pelz, 1978; Beyer & Trice, 1982). This tripartite classification continues today as the dominant classification of findings about information utilisation. For example, a recent study of professionals involved in child welfare services in the United States by Hutchinson concluded that "although conceptual and symbolic uses of research-based knowledge are indicated in this sample, ... instrumental use predominates" (Hutchinson, 1995). Instrumental utilisation is associated with the conceptualisation of information utilisation as end-state; conceptual utilisation is primarily associated with interactive change process, and symbolic utilisation overlaps both conceptualisations. Overall, the focus on conceptual utilisation has received considerably less attention than instrumental utilisation in the literature of the field.

2.4.1 Instrumental utilisation

Instrumental utilisation describes the range of organisational outcomes, impacts and end-states. Instrumental utilisation is concrete and clearly observable. According to Rich, instrumental utilisation involves acting on research results in specific, direct ways where "respondents cited and could document ... the specific way in which information was being used for decision-making or problem-solving purposes" (Rich, 1977: 200). While it could be argued that symbolic and conceptual utilisation can be cited and documented, and by Rich's definition be considered as instrumental, instrumental utilisation is about practical applications and actions for change,

describing the physical changes in practice and procedures which are a direct result of applications of information. Hutchinson, for example claims that instrumental use is "purposive in nature and often linked to change" (Hutchinson, 1995: 97). The literature provides many indicators of instrumental utilisation, for example, when the utiliser "adopts a fixed set of recommendations prescribed by the scientist" (Sunesson & Nilsson, 1988: 142); when there are "new actions" (Hultman & Hörberg, 1995: 343); and when "explicit and practical direction on matters" is provided (Hutchinson, 1995: 97).

Given the focus of instrumental utilisation on observable actions and outcomes, a range of scales has been developed to classify types of utilisation and nonutilisation, and to distinguish purposes of utilisation, types and levels of utilisation. These scales are primarily instrumental in nature, though they deal with some aspects of conceptual utilisation. These scales have been perpetrated through two decades of replication. An example of establishing types of utilisation is Larsen's Categories of Use, made up of: Considered and rejected; Nothing done; Under consideration; Steps taken; Partially used; Used as presented; and Used and adapted (Larsen, 1985). An example of establishing levels of use is provided by Hall, Loucks, Rutherford & Newlove (1975) and Hall & Loucks (1977). They developed 8 levels of decision points to measure what people do in relation to implementing innovation, referring to it as Levels of Use of the Innovation (LoU). The levels are: Nonuse, Orientation, Preparation, Mechanical Use, Routine, Refinement, Integration, and Renewal (Hall & Loucks, 1977: 266-7). Owens' Indices of Knowledge Utilization (1983) provide a typology for level of use, breadth of use, and depth of use related to publications in the field of education. Dunn, Holzner, Shahidullah, & Hegedus (1987) developed a set of broad-based Social Impact of Science (SIS) indicators, based on distinctions among types and levels of social goals. Other scales that have been developed include Johnson's Evaluation utilisation scale (1980), and Pelz & Horsley's Research Utilisation Index (1981).

2.4.2 Conceptual utilisation

While the findings of conceptual information utilisation are limited compared to that of instrumental utilisation, they do identify some common ideas. Generally conceptual information utilisation is an umbrella term that loosely

categorises what happens in people's minds when they do something with information; that is, how information influences their "thinking about an issue without putting information to any specific, documentable use" (Rich, 1977: 200). Larsen defines conceptual utilisation as "knowledge which is under consideration, either explicitly or implicitly" (Larsen, 1980: 428), and involves using information in less specific, more indirect ways than in instrumental use. Huberman presents conceptual utilisation as an activity "in which one processes information, construes and reasons about one's professional practice" (Huberman, 1983: 495). Weiss, preferring to label conceptual utilisation as "enlightenment", considers it to be the "gradual sedimentation of insights, theories, concepts and ways of looking at the world" (Weiss, 1977: 535). Hutchinson, in a replication of Weiss & Bucuvalas's (1980b) study, also use the term enlightenment, defining it as "the acquisition of ideas that become part of a person's general store of information" (Hutchinson, 1995, 103). Similarly, Owen, Lambert & Stringer posit enlightenment as gaining a fundamental knowledge of the plan and conduct of the evaluation and a conceptual understanding of the findings related to the intervention (Owen, Lambert & Stringer, 1994: 273).

These definitions highlight a number of important attributes of conceptual information utilisation. Its focus is on people actively thinking about information that has been made available to them, rather than on the end product of overt behaviours and actions that may result. It is internal rather than external - cognitive rather than physical, and it relates to knowledge people already have. It suggests that mentally working with information has some effect. In essence, conceptual utilisation is about cognitive processes and change; it describes the changes in the way people think about the world. This is clearly expressed by Kennedy (1984). Kennedy posits that while instrumental utilisation is based on making a decision and oriented towards action and behavioural change, conceptual utilisation is a formative mental process based on human information processing. She views conceptual utilisation as transformative, where information is incorporated in a person's store of knowledge, where it is translated and then applied to working situation in actions as instrumental use.

Kennedy's research (1983; 1984) also establishes that existing knowledge, defined as the entire array of existing beliefs, assumptions, interests and experiences of people, is an important basis for interpreting new evidence

and for judging the validity and applicability of each new source of evidence encountered, and for influencing the behaviour of individuals. Hall, George & Rutherford similarly place importance on the role of people's existing knowledge in conceptual information utilisation. They present the notion of a "cognitive concern" as a state of cognitive readiness for information utilisation. A cognitive concern is "the composite representation of the feelings, preoccupations, thought and consideration given to a particular issue or task". They argue that each person perceives and mentally contends with a given issue differently, and that this is shaped by "personal make-up, knowledge, and experiences. ... The intensity of the arousal will depend on the person's past experiences and associations with the subject of the arousal, as weli as how close to the person and how immediate the issue is perceived as being" (Hall, George & Rutherford, 1986: 5).

It is also acknowledged that while conceptual utilisation is less tangible and less observable than instrumental utilisation, it is no less complex. Some of the early literature on conceptual information utilisation tended to mask its complexities. For example, Beyer & Trice made the claim that :

> "conceptual use of research for general enlightenment demands much less of users than instrumental use ... does not require immediate, direct application, ... is not so inhibited by the constraints of customary or prescribed repertoires of behaviors" (Beyer & Trice, 1982: 599-60).

The findings in relation to conceptual utilisation also suggest that it is not just an accretive or additive process, but one in which available information acts as an ingredient for the synthesis process rather than as an immediately applicable tool or solution. It is a continual, ongoing "shaping" process. Cousins & Leithwood describe it as the "educative" use of information where "available information may be used to shape more or less directly the thoughts and actions of a person" (Cousins & Leithwood, 1993: 307), and where "one learns from information, such learning eventually having an indirect bearing on one's thoughts and actions (Cousins & Leithwood, 1993: 309).

The question of what is the specific nature of conceptual information utilisation is not so firmly established. A major barrier to understanding its complexity has been the absence of reliable and valid research

methodologies that probe into the human mind, to establish what people actually do cognitively with the information that they are provided with in the course of their lives. The available research tends to conceptualise conceptual information utilisation as cognitive process or outcomes. Weiss & Bucuvalas (1980), Weiss (1986), Kennedy (1983), and Hall, George & Rutherford (1986) provide some important insights in this respect. The following analysis of these studies show that no cumulative and integrated picture of conceptual utilisation has yet been established.

In the context of a discussion of 155 decision-makers in mental health fields, Weiss & Bucuvalas have provided a range of examples of cognitive effects, including "understand the background and context of program operation", "focus attention", "stimulate", "provide new understandings" "clarify their own thinking", "reorder priorities", "make sense", "reduce uncertainties", "create new uncertainties", "provoke rethinking", "provide a sense of how the world works", "support positions", and "persuade others" (Weiss & Bucuvalas, 1980b: 305); and "general pragmatic guidance", "legitimation", and "sensitivity to new concepts" (Weiss, 1986: 419-420).

Kennedy's research (1983) identified a number of cognitive techniques by which policy makers and programme managers of school districts incorporated new evidence into existing knowledge. These were: retaining selected evidence in its original form; reducing complex evidence to succinct proposition that could be retained; rendering evidence meaningful by interpreting it and often resulting in retaining the interpretation rather than the evidence itself; and creating inferential bridges between the evidence and other elements in the working knowledge. Her study concluded that new information is not merely added to existing knowledge and remained unchanged from one situation to another, rather, it is sorted, sifted, interpreted, reduced to simple propositions, translated into implications, and transformed into bridging inferences.

Hall, George & Rutherford explored the notion of cognitive concern as stages of conceptual utilisation in the context of "teacher concern" about innovation. These stages shed some light on approaches to developing constructs of conceptual information utilisation. The arousal and resolution of concerns were identified in terms of the following developmental patterns and measured using the Soc Questionnaire: Awareness, Informational, Personal,

Management, Consequence, Collaboration, Refocussing (Hall, George & Rutherford, 1986: 7). "Awareness" refers to cognitive knowing about the concern, but little involvement is indicated. "Informational" is a general awareness and interest in learning more detail. "Personal" refers to consideration and analysis of an innovation from a personal perspective, including considerations of potential conflicts with existing structures or personal commitments. "Management" refers to considering processes and tasks of using the innovation, and considering its impact in terms of external outcomes such as organising, efficiency, scheduling and time demands. "Consequence" is where attention is focused on assessing the relevance of the innovation for students, including student performance and competencies. "Collaboration" focuses on coordination and cooperation with others regarding use of the innovation. "Refocussing" refers to consideration of more universal benefits from the innovation. Each of these stages represented an assessment of the extent of mental attention given to an innovation, and provide an approach to establishing cognitive effect.

The work of Dervin and colleagues on the nature of information and how it is utilised is also pertinent in this context. This work largely rests on four key assumptions: that information does not inform people unless they can make personal sense of it; people construct reality by processing information in the frame of personal understandings; people utilise information based on their perceptions of how they see the situation they are in, and people make use of messages in terms of the helps they are seeking for the situations they are in (Dervin, Harlock, Atwood & Garzona, 1986: 392). In an in-depth study of patients' health situation and their perceptions of the helpfulness of the information provided to them by doctors, a number of utilities were used by patients to assess whether answers helped or did not help them move through their situations. These utilities could be construed as cognitive effects of the information conveyed in doctors' responses to questions asked. The utilities identified in this study included: got encouraged; got new / altered specified pix; got new / altered general pix; could see the road ahead; identified possibilities; found direction / planned; got away from bad feelings; and avoided pitfalls; arrived / made progress (Dervin, Harlock, Atwood & Garzona, 1986: 602).

Similarly, in a study for the California State Library that sought to identify the information needs of Californians and to elaborate ways libraries could

usefully help with these needs, Dervin identified a number of help categories, some reflecting cognitive processes, and other reflecting affective dimensions. The help categories were: creating ideas, finding directions or ways to move, acquiring skills, getting support or confirmation, getting motivated, getting connected to others, calming down or relaxing, getting pleasure or happiness, and reaching goals (as reported in Dervin, 1992: 75).

The perspective of information utilisation as interactive change process acknowledges that conceptual utilisation and instrumental utilisation are not isolated, separate entities. Rather, conceptual utilisation is seen to lead to a range of "second-order" effects or outcomes, one of which is instrumental utilisation, such as developing and implementing a programme, clarifying an existing programme design, or making changes to the delivery of a programme (Beyer & Trice, 1982). Conceptual utilisation is thus formative, leading to a summative element associated with instrumental utilisation. It has also been argued that conceptual utilisation is a necessary condition of instrumental utilisation. Weiss (1977) for example suggested that conceptual and instrumental utilisation do not lie at opposing ends of a continuum, rather, instrumental utilisation was a subset of conceptual utilisation, whereas conceptual utilisation was itself equivalent to the process of learning and knowing. In a study of the National Opinion Research Center, Rich (1977) identified two waves of utilisation. The first, from when information was initially received to three months later, was mainly instrumental utilisation, shown as discrete actions of regulation writing, writing memos to supervisors, and briefing employees and meetings. In this phase, information input were oriented toward "action" in the policy sphere. The second wave, three to six months later, was conceptual utilisation, where information inputs were oriented toward gaining a better "understanding" of the policy context in which the actions took place (Rich, 1977: 204).

While conceptual utilisation has been broadly indicated in terms of mental processes of various kinds, levels of cognitive awareness, or cognitive outcomes, it has tended to focus on surface properties of information, taking for granted the meanings of information and knowledge, and taking for granted that all knowledge is of value and has utility. Writers have not distinguished between people's thinking which affects actions and that which does not. A particularly dissenting voice comes from Karapin. He sees the use of the term "enlightenment" as deceptive, claiming that conceptual

utilisation may result in "endarkment" rather than enlightenment, and questions where "ordinary" knowledge such as common sense and speculation" fit in (Karapin, 1986: 254). He asserts that these negative dimensions of conceptual utilisation are rarely explored. (Larsen's Categories of use [1985] is one exception.) He concludes that in the absence of any way of measuring these negative dimensions, the definition is vague because it tends to exclude the important possibility that the information is not utilised at all (Karapin, 1986).

Some writers have expressed problems with the classifications of instrumental and conceptual utilisation. For instance, Huberman is critical of the attention given to instrumental utilisation. He claimed that such operationalisations were construed as too heavily "rationalistic" in the sense of assuming a "utilitarian" motive in the user organisation. He regarded this as a naive, linear view of information utilisation, on the basis that utilisation was much more highly selective (cognitive) and strategic or symbolic. He claimed:

> "If I am an "instrumentalist", I am assuming a more passive, "reproductive" user of research information. ... From a transactional or conflict-theoretic perspective, users are active strategists who transform information to preserve cognitive consonance or to legitimate interventions within a "bargained" social environment" (Huberman, 1987: 590).

Levitan & Hughes also identified some concerns. They claimed that the definitions of instrumental and conceptual utilisation, and their use as the standard classification of findings have perpetrated a simplistic "impact" definition of utilisation (Levitan & Hughes, 1981: 531), and have set an unrealistically clear demarcation, that is beginnings and ends, between conceptual and instrumental utilisation.

2.4.3 Symbolic information utilisation

Symbolic information utilisation involves utilising research results to legitimate or sustain predetermined positions, such as taking information selectively or otherwise distorting it to justify actions taken for other reasons (Pelz, 1978: 347-352). According to Weiss (1986) it may involve utilisation of information for political motives, where information becomes the ammunition

for the side that finds its conclusions congenial and supportive. Instances of symbolic information utilisation include: using information for self-serving purposes of justification; personal aggrandisement; to support a predetermined position; to give confidence to advocates of a position, to reduce uncertainties, to provide an edge in a continuing debate, and to neutralise opponents. It may also involve utilisation for tactical reasons, where information is used for purposes that have little relation to the substance of the research; used as proof of responsiveness, used as a tactic for delaying actions, to deflect criticism, to avoid responsibility for unpopular policy outcome, tactic for enhancing prestige of organisation by allying with researcher of high reputation.

The analysis of Feldman & March (1981) highlights some of these issues. They argue that the utilisation of information in organisational settings is highly symbolic, claiming that much of the information gathered and communicated has little decision relevance; that it is not considered in decisions for which it was originally requested; and that regardless of information available at the time a decision is first considered, more is often requested. They conclude that the gathering of information and its conspicuous consumption provide a ritualistic assurance that appropriate attitudes about decision making exist; provide a visible command of information and information sources that enhances competence and inspires confidence, and demonstrate an ability to use information easily and appropriately. Collectively, asking for information, utilising information, budgeting for information, and displaying information are symbols that the information process in the organisation is legitimate, that the members of the organisation are good decision makers, and that the organisation is well managed (Feldman & March, 1981: 177-178).

Levitan & Hughes (1981) further consider "persuasive" use, where research is presented to try to convince others of a political position, or to defend such a position from attack. The question of influence or tactics or politics is not substantially addressed in the literature, and in some cases tends to be regarded as conceptual rather than instrumental because the effects of research are diffuse, indirect, hard to pin down and often scarcely visible. In the main, symbolic information utilisation as a separate classification of utilisation is cloudy, and it could be argued that the instances cited as

indicators of symbolic utilisation might well be cited as instrumental or conceptual.

In summary, two broad perspectives of information utilisation appear in the literature: more predominantly there is an end-state perspective, and a more recent and less developed perspective of interactive change process. Consistent with these perspectives is the classification of indicators of information utilisation as instrumental, conceptual and symbolic. The context of this classification is primarily organisational; the information base is the findings of wide-ranging social science research; and the focus is chiefly the adoption, implementation and institutionalisation of this information in tangible, immediate and direct ways.

2.5 CONTEXTUAL FACTORS SHAPING INFORMATION UTILISATION

An important aspect that is common to both broad perspectives of information utilisation, and that features in the discussion of research findings is the consideration of the contextual elements that shape information utilisation. In the literature, these elements are commonly referred to as "frames of reference". Frames of reference are defined as the basic elements in the definition of a situation which govern a person's involvement in the situation; they enable people to assess what the situation ought to be for them, shape judgements and then determine when action is acceptable, and what that action might be. In the specific context of information utilisation, they are the elements of a situation through which people filter incoming information before deciding whether to take it seriously or disregard it. They are the reference points for sources of meaning and points of comparison, and are seen to inform and regulate processes and activities by setting boundaries or barriers around what is considered to be relevant limiting domains (Goffman: 1973; Lantz, 1984; Weiss & Bucuvalas, 1980b; Holzner et al, 1976; Holzner & Fisher, 1979). According to Dunn, Holzner, & Zaltmn, a frame of reference is "the structure of assumptions and implicit or explicit decision rules in inquiry which provides the framework for the construction of meanings. It provides a perspective that focuses attention, but it also sets boundaries for what is to be considered the field of relevant information" (Dunn, Holzner, & Zaltmn, 1985, 2833). Holzner & Fisher further add that these frames, often highly standardised or codified, are "akin to the lens through which an observer

looks: the resulting knowledge is what the observer sees" (Holzner & Fisher, 1979: 231-2).

It is clearly acknowledged in the literature that frames of reference play an important role in information utilisation. Indeed, a considerable portion of the so-called information utilisation research is not directly about information utilisation as behavioural "doing" or cognitive "doing" per se, rather, it is a study of the frames of reference that surround information utilisation and help explain its nature.

There is agreement in the literature that a person's frames of reference not only establish meaning for that person, but also guide and shape cognitions and actions, and provide expectations as to how deeply and fully the individual is to be carried into the activity organised by the frames. Weiss & Bucuvalas claim that "frames of reference establish a kind of intellectual and social 'comfort zone' and an item of information whose meaning could cause an agency to operate outside this comfort zone will tend to be rejected." (Weiss & Bucuvalas, 1983b: 66)

An extensive range of frames of reference considered to contribute to information utilisation have been identified. Werdelin (in Lantz, 1984) identifies four categories of frame factors that shape the feasibility of information utilisation, and a considerable number of individual studies support each category. The four categories are:

1. *external frames*: these are factors outside the individual, the contextual elements of a person's situated reality that affect the activity in question. These include demographic characteristics such as age, gender, educational level, and income; organisational and environmental characteristics, as well as personal attributes of others such as their attitudes, opinions, and emotions (Dickman, 1981; Fletcher, 1991; Lantz, 1984).

2. *frames of resources*: these include nature of resources; economic restrictions, availability of materials, personnel, availability / knowledge / skills of people involved and frames of preparedness. Examples include: qualities of information and characteristics of sources of

information such as credibility of source, authority, or tradition (Johnson, 1980).

3. *factors influencing the preparedness for the activity*: laws, regulations, structure of society, environmental attitudes, attitudes, opinions, emotions found in group involved. Examples include: political (Florio & Demartini, 1993), organisational (Weiss & Bucuvalas, 1983b; Johnson, 1980), and socioeconomic elements (Johnson, 1980).

4. *internal frames*: these are aspects of the person's model of the world, and include background, knowledge and skills, attitudes, opinions, motivations of individuals. Examples of these include: existing knowledge structures (Holzner & Fisher, 1979; Johnson, 1980); values and norms (Zaltman, Duncan & Holbek, 1973; Rogers 1983); goals and commitments (Florio & Demartini, 1993); cognitive style (Carver, 1992; Henshaw, 1991); motivations, assumptions, conventions, and premises (Scarpino, Dunn & Mitroff, 1983).

Primary attention has been given to exploring external frames, frames of resources and factors influencing preparedness for the activity. The question of how internal frames of reference such as existing knowledge, styles of information processing and attitudes and values shape information utilisation is an open one. Holzner & Fisher see this as a fundamental question, claiming that as knowledge is transposed from one domain to another, "it seems to us that the nature of the transformation itself is insufficiently understood" (Holzner & Fisher, 1979: 238). While there is recognition that existing knowledge structures, attitudes, and beliefs impinge on the information, interact with the new information and each other so that the constantly emerging process transforms the terms of the interaction as it goes along, the research evidence is contradictory. In essence, researchers seem to agree that regardless of the character of outside variables, what actually happens in the individual process of information utilisation is open to great variation. According to Holzner and Fisher "the nature of frames of reference and their dynamics and decision rules may channel or limit both cognitive and practical efforts" (Holzner and Fisher, 1979: 242). They ask the fundamental question: "how does knowledge synthesis proceed?" (Holzner and Fisher, 1979, 238).

Zaltman (1979) and Wingens (1990) indicate that while there is considerable research into frames of reference, it is diverse and fragmented, and not brought together into a cumulative whole. They claim that overall, little research specifically addresses the interaction between determinants affecting social construction of reality and information acquisition and utilisation. Lantz (1984) suggests that the problem area needs to be seen from a context-bound holistic and user-centred perspective, and that we need intrinsic studies which can guide our understanding of human information situations with regard to contextual factors.

The question of internal frames of reference is critical to the research design of this study. Researchers such as Rich (1991) and Dunn & Holzner (1986) acknowledge the difficulty of measuring information utilisation per se; when measurement is placed in the context of multiple contributing frames of reference, the complexity of measurement is increased. Dunn & Holzner claim that the "cognitive content and social functions of knowledge in society [represent] one of the key intellectual and practical problems of the late 20th century" (Dunn & Holzner, 1986: 4). Karapin also recognised this complexity when commenting that "the world view of the knower determines how knowledge is interpreted. ... The knowledge generated is self-knowledge as well as knowledge of objects. Knowing is subjective; knowledge and action are intimately related" (Karapin, 1986: 242). How this study deals with the complexity of frames of reference is elaborated in Chapter 3.

2.6 THE CURRENT STATE OF INFORMATION UTILISATION RESEARCH: IDENTIFYING THE GAPS

Thus far, this review has highlighted information utilisation in terms of two broad perspectives: information utilisation as end-state, and as interactive change process. Empirical research emerging out of these two perspectives has generated the dominant classification of information utilisation as instrumental, conceptual and symbolic, with instrumental utilisation having received the greatest amount of attention. It has also established the role of frames of reference in surrounding and shaping these types of utilisation. This backdrop provides the framework for establishing the positioning of this study.

Wingens claims that despite the bulk of empirical research into information utilisation conducted since the 1970s and the increasing amount of scholarly attention given to it, the state of the art of theory building has remained on a low level, and is at best, mediocre:

> "There is no elaborate utilization theory, let alone one that has proved its explanatory power by empirical testing. Rather, the state of the art of utilization theory is adequately described by 'ad hoc generalizations' derived and attached to some of the numerous empirical studies which inevitably are very specific investigations and therefore cannot provide a proper basis for theoretical generalization" (Wingens, 1990: 28).

He concludes that "It is time for utilization research to undertake greater theoretical efforts toward constructing a general utilization theory" (Wingens, 1990: 31), and believes that a paradigmatic shift in utilisation research that stresses the "active-creative role of the user for the process of use, explicitly talking of cognitive transformation, knowledge conversion, adaptation, reformulation, or re-invention" (Wingens, 1990: 37), and understanding these changes are important steps forward.

This view is supported by Sunesson & Nilsson. They assert that there is still a continued tendency in information utilisation research to attribute to users a passive role as mere receivers of stimuli; as merely reactive. They claim "there is a mechanistic or behavioristic conception of research use in the very notion of knowledge as something that 'creeps' into the organization from without, something organization members are exposed to, without actively pursuing it" (Sunesson & Nilsson, 1988: 143). They consider that the current information utilisation research would be enriched by both sociological investigations of utilisation contexts, and on the activities of users that go beyond the descriptive categories and normative models.

Rich, in reviewing his role as Editor of the journal *Knowledge: Creation, Diffusion, Utilization* in 1991 echoes Wingens and Sunesson & Nilsson. He concludes that "theory with respect to knowledge utilization is not well developed" (Rich: 1991: 322), and that few researchers have moved beyond "the rather primitive distinction between instrumental and conceptual types of utilization. Indeed, one might uncharitably argue that only one type of utilization has been identified, namely, instrumental use" (Rich, 1991: 331).

He also asserts that the focus on instrumental utilisation that has dominated the utilisation research is "so broad that it camouflages the complex interactions that produce a ... decision" (Rich, 1991: 325). While he recognises that many studies make elusive connections between cognitions, attitudes, information acquisition and utilisation, the instrumental focus has meant that few studies have characterised "actors" in early stages of the utilisation process, nor considered the nature of these interactions.

The comments of Wingens, Sunesson & Nilsson, and Rich suggest that research that moves away from a conception of information utilisation as end-state to one that focuses more holistically, and more in depth, on people as active and creative processors of information would be an important step forward. They highlight the need to focus on information utilisation as an interactive change process, particularly taking into consideration the nature of cognitive processes in information utilisation.

This research gap is further highlighted by a review undertaken by Dunn to identify a number of contending models of information utilisation. Some of these models have been supported in Hutchinson's later review (1994). The models, which also give emphasis to frames of reference, are:

1. *product contingent model*: the characteristics of publicly recorded knowledge (eg. form, content, language, length, reliability, validity, timeliness etc.) determine the scope of information utilisation. Variations in information utilisation are a function of the form in which information is embodied or stored, its level of abstraction, its reliability and validity.

2. *inquiry-contingent model*: differences in modes of inquiry determine scope of information utilisation. Variations in information utilisation are a function of the quality of procedures used to monitor and evaluate diffusion, adoption and implementation of innovations such as type of research design, style of concept formation, observation methods, and sampling.

3. *problem-contingent model*: the characteristics of the problem (levels of conflict, uncertainty, risks associated with attempts to satisfy need) determine the scope of information utilisation. Variations in information

utilisation are a function of the nature and complexity of problems whose resolution may require particular kinds of information.

4. *structure-contingent model*: variations in the structure of an organisation (authority, responsibility, power and incentive systems) determine the scope of information utilisation. Variations in information utilisation are a function of the affiliation of change agents to the sponsoring organisation and the presence of independent outside evaluators. Hutchinson refers to the focus on the organisation's structure and functions as the *atomistic-mechanistic approach*;

5. *process-contingent model*: the nature of the interaction among producers and potential users and beneficiaries of knowledge determines scope of information utilisation. Variations in information utilisation are a function of the total influence exerted by change agents, sponsors and targets in various phases of the policy-making process. (Dunn, 1991: 517) Hutchinson refers to this as the *communications network (systems) approach*.

What is noticeable in the models proposed by Dunn (1991) is the absence of a model that could be labelled *cognitions-contingent model*, where the nature of the cognitive interaction between existing knowledge and new information determines the scope of information utilisation. Hutchinson's later review (1994) identifies this model as an emerging area of interest, and conceives of it in terms of two approaches: a *microinteractional approach,* which involves fine-grained observation and interpretation of the behaviours of people; and a constructivist *approach*, which looks at human knowledge as a constructive product of cognitive acts.

The absence of what might be called a *cognitions-contingent model* underscores the conclusion of the researcher that a major gap exists in terms of our understanding of the cognitive dynamics of information utilisation. It is the specifics of these cognitive dynamics, from the perspective of the people involved, that need to be understood more fully. Thus this research will focus on providing a richer understanding of cognitive information utilisation. Such understanding will not only complement our understanding of information utilisation as an interactive change process, but also enable further research

into instrumental, conceptual and symbolic utilisation to be dealt with more holistically.

2.7 RESEARCH APPROACHES

Given that the focus of this research is to understand cognitive information utilisation more fully, some analysis of inquiry methods is warranted to provide directions as to how this research might be addressed. At a general level, the study of information utilisation is characterised by diversity of research designs ranging from case studies to cross-sectional analyses conducted in representative contexts of practice. The most common methodological approach is the survey and case study method, with very few longitudinal studies, quasi-experimental and experimental designs. The prevailing method is the self-administered questionnaire. Respondents typically are asked about the details of their information utilisation, and a utilisation score is developed to determine impact. Less use is made of content analysis, naturalistic observation, and interview. Very few studies use qualitative methodologies, or analyse data qualitatively. There also appears to be little attempt to capture the underlying contextual meanings attached to the information, its cognitive processes and applications from the perspective of the individual .

Mandell and Sauter (1984), Dunn, Dukes & Cahill (1984), and Rich (1991) claim that empirical investigations of information utilisation have been plagued by methodological problems resulting in extreme variation in results, and this has been a major obstacle to the development of accurate and generalisable findings. Mandell and Sauter identify a range of contributing factors, chiefly problems with poor or no conceptualisation and specification of the dependent variable "use", and a failure to appreciate respondents' inabilities to report and explain their behaviour accurately (Mandell and Sauter, 1984: 147).

Another common concern is that considerable research has been based on procedures with unknown or unreported reliability and validity. Mandell & Sauter, for instance, claim that information concerning the convergent and discriminant validity of different conceptualisations of utilisation is virtually non-existent, and that the heterogeneity among various measures of use has led to contradictory results:

> "Most fundamentally, rather than simply referring to the umbrella term use, it is essential that researchers explicitly identify the specific measures of use being considered. Researchers have also failed to recognise and account for interactions among independent variables properly. The unwarranted reliance on respondents' introspection means that the validity of responses is extremely problematic" (Mandell & Sauter, 1984: 147).

This brief analysis reinforces the need to situate the study more holisitically in a perspective of information utilisation that goes beyond what Mandell & Sauter (1984) refer to as a narrow, decisionistic characterisation of "use", that is, extent to which recommendations flow from analytically-based information. More specifically, it raises implications for the design of the study. It mandates clear conceptualisation and operationalisation of the focus concept of cognitive information utilisation, and the development of a methodology that goes beyond surface considerations of the concept, to one that enables indepth inquiry to take place. It also highlights the need to document carefully procedures and discussion related to validity and reliability issues.

2.8 SUMMARY AND IMPLICATIONS FOR THE STUDY

The assumption that means precede the attainment of ends underpins the substantive literature on information utilisation. It has given rise to models of information utilisation that are largely input-output models, and research questions that focus on sources, organisations, external behaviours, observable actions and outcomes. At best it is a mechanistical portrayal of information utilisation where information, largely the findings of social science research, transfers from domains of knowledge production to organisational domains of deficit, perhaps ignorance. Conceptualising information utilisation as a type of organisational change or end-state has tended to mask the complex social and cognitive exchanges that occur, and has limited explorations into the contexts of human information processing and the cognitive and social processes that structure them. With a transmission of information focus that assumes that information has an existence apart from human construction, people play a passive role, attributed a role as mere receivers of stimuli, merely reactive, rather than as initiators and manipulators of knowledge. Indeed, information utilisation is seen as the problem, not as a process of responding to another problem.

There is, however, increasing acknowledgment that information utilisation is not just about examining end-states at any one point in time, rather, it is a more holistic process over time involving cognitive procedures and transformations that occur within the mind of the individual when working with information. From this perspective, information utilisation may be understood as a process of knowledge creation by individuals, where available information acts as an ingredient for the analysis and synthesis process, transforming existing knowledge, rather than as an immediately applicable tool or solution. While it is apparent that the process of information utilisation has to be understood before information can be translated into action, the study of information utilisation to date has focused more attention on eventual utilisation rather than on the interactive process between people's existing knowledge and new information. The outcome is that comparatively less attention has been given to developing an empirical base for better understanding information utilisation as an interactive change process. Limited attention has been given to understanding the cognitive dimensions, including how existing knowledge changes, and the cognitive effects of this interactive process. It is this gap that is the central focus of this study.

Cognitive information utilisation is concerned with what happens in people's minds when they do something with information that is made available to them, as opposed to being concerned with external, observable behaviours and actions that may be an end result. It is concerned about how information changes what they already know, and what are the cognitive effects of this interaction. In focusing on cognitive information utilisation, the following general assumptions, suggested from the preceding review, underpin this research:

(a) Information has the potential to make a difference. Individuals involved in utilising information might have acted differently or thought differently in the absence of information;

(b) Information needs to be known in order to be utilised and this involves a communication process;

(c) information utilisation is interpreted and constrained by various people in terms of their own frames of reference;

(d) information utilisation is transactive, rather than exchanged or transferred;

(e) information utilisation involves cognitive processes in relation to taking in information; these cognitive processes result in cognitive effects;

(f) information does not always evoke an overt, discernible response;

(g) simply making information available is not sufficient to ensure its utilisation.

The discussion to this point has given primary attention to exploring conceptions of utilisation. It has not addressed concepts such as information, knowledge and knowledge structures, although it has referred to these concepts a number of times, and made some assumptions about them. These concepts are acknowledged as central concepts in the study of human information processing from a cognitive viewpoint, as identified in Chapter 1.1. These concepts will be elaborated in the context of Brookes' Fundamental Equation, posited as an equation of cognitive information utilisation, and as the conceptual framework for this study.

PART 2 BROOKES AND THE CENTRAL CONCEPTS OF INFORMATION UTILISATION

2.9 THE FUNDAMENTAL EQUATION AS AN EXPRESSION OF COGNITIVE INFORMATION UTILISATION

Given the focus of this study on cognitive information utilisation, this part of the literature review presents a detailed analysis of Brookes' Fundamental Equation as a conceptual framework for examining cognitive information utilisation. It commences with an overview of the foundation of Brookes' equation based on the philosophy of Karl Popper, and situates it in the broader context of information science. It then examines the theoretic perspective of each component of the equation and the assumptions that underpin it. It provides an analysis of the central concepts that make up the equation - knowledge, information, and knowledge structures. These concepts are presented as central concepts in examining cognitive information utilisation. This analysis contributes to developing an approach

to empirically investigate cognitive information utilisation, with Brookes' Fundamental Equation as the conceptual framework.

2.9.1 Origin and background of the Fundamental Equation

Brookes attributed the philosophical writing of Sir Karl Popper (1972) as the starting point for his postulation of the Fundamental Equation and his elaboration and analysis of the interrelationship of information and knowledge. In the context of the growth of knowledge, Popper presented an ontological scheme of three interactive yet independent worlds in which he saw the growth of human knowledge was embedded:

> *World 1*: the physical cosmos;
>
> *World 2*: the world of conscious experiences, subjective human knowledge or "mental states" as active centres; and
>
> *World 3*: the world of objective knowledge, the products of human mind as recorded and stored in artefacts; the world of the logical contents of books, libraries, computer memories, and suchlike which are available, accessible, and static, unable to regenerate of themselves. (Popper, 1972: 74)

Popper established both World 2 and World 3 as cognitive, World 2 being a state of mind, a disposition to act, and World 3 being the products or objects of thought. He clearly distinguished between the mental process and the thought content, claiming that "thoughts in the sense of contents or statements in themselves, and thoughts in the sense of thought processes, belong to two entirely different worlds" (in Neil, 1982, 34).

Directly related to and drawing on Popper, Brookes considered the objects of World 3 as cognitive and not as physical (World 1) objects, on the basis that World 3 contained the logical content of books, the thoughts themselves embodied in language, written or spoken, which humans produced or expressed. World 2 was how the mind manipulated the thoughts in the process of problem solving through acting on the information contents. Once thoughts resided in World 3, being outside the human mind, they were not controlled or influenced by the individual who produced them. Brookes also

thought of objective knowledge in World 3 as the current consensus, perhaps truth. Brookes considered that the theoretical pursuit of information science should be the study of the interaction between World 2 and World 3, that is, the interaction between the private, inaccessible and unique knowledge of people, and the public documented artefacts of knowledge (Brookes, 1980d: 248).

With a focus on an interaction between Popper's World 2 and World 3, Brookes expressed the cognitive process of what people know, how what they know changes, and the effect of these changes as an abstract equation $K[S] + \Delta I = K[S + \Delta S]$ (Brookes, 1980a: 131). This Fundamental Equation, expressed in pseudo-mathematical form "because it is the most compact way in which the idea can be expressed" (Brookes, 1980a: 131) suggested that a person's existing knowledge structure K[S] is changed by an increment of information ΔI, and this modification has some effect, a changed knowledge structure $K[S + \Delta S]$ where ΔS indicates the effect of the modification. The changed knowledge structure is a function of the properties of the exiting knowledge structure. Brookes asserted that the change is not accretive but some adjustment to the structure. He further acknowledged that "the mathematicians will note that my terms and symbols are undefined" (Brookes, 1980a: 131), indicating that the equation was not to be interpreted in a strict mathematical sense, rather, it was a concise and convenient way of expressing and writing down an important idea.

Brookes' equation presents a dynamic picture of a person's knowledge undergoing change. In essence, Brookes presented an equation of people doing something cognitively with information; an equation of information utilisation that explicitly focused on the cognitive dimension. Brookes recognised the enormity of the research task ahead for the field in this regard:

> "as we do not know what a knowledge structure is, the equation defines the unknown in terms of another unknown and a process in a vicious circle of very small radius. The fundamental problem of information science is to interpret this Fundamental Equation and it will have to do it by widening the vicious circle until the radius is so big that no-one notices that the circle is still circular. We can then claim to have 'explained' information processes. It will take a long time " (Brookes, 1975a: 48).

Brookes' Fundamental Equation is not the only equation about cognitive information processing proposed for information science. Collectively Brookes' equation and others reflect the field's attempt to establish the essence of an evolving information science. The equation of Shreider (1965) predated Brookes by some ten years. Shreider claimed that people have a "guide" in which is recorded their knowledge about the external world. This guide, or "thesaurus" is denoted by Ø. Received statements, T change the state of the thesaurus, and thus act as transformations of the thesaurus. In proposing this equation, Shreider defined the amount of information I(Ø,T) as the degree of change of the thesaurus Ø under the action of a given statement T. Shreider concluded that the amount of information contained in the statement T with respect to the thesaurus Ø could be characterised by the degree of change of the thesaurus under the action of the statement. While Shreider was concerned with the mathematical definition of the quantity of information, his notion of the transforming relationship between Ø and T reflects the idea of cognitive change that is at the heart of Brookes' equation.

In a similar vein to Brookes is the equation of Yovits et al (1987). The equation is $\Delta I = aF1(DME)\ F2(DME)$, where the change in information (ΔI) is a product of the amount of knowledge in an external document (a), the learning capacity of person to incorporate external knowledge into the information state (F1) and the external knowledge not already known and incorporated into the information state (F2). This product indicates how well a person, as a decision maker, performs, that is, decision maker effectiveness (DME).

Yovits et al were interested in the way external documentation such as books, data, references, and messages, changed an average decision maker's effectiveness for a particular problem. Their definitions of information and knowledge are the reverse of those of Brookes, with knowledge, as the contents of external documentation being converted to information when utilised by a decision maker. Where Brookes referred to "knowledge structures", Yovits et al referred to "internal information state" (Yovits et al, 1987: 406). They considered that external documentation was not information, rather, it gave rise to information, in that these external documents had the potential to change the information state of the decision maker:

> "For want of a better terminology, let us call the contents of the external material knowledge. ... The knowledge contained in the external documentation is of course constant. It does not change with time (although its use will). In any particular situation this material may be converted to information by a particular decision maker. *Knowledge has the potential to become information.* ... The knowledge from the external documentation is the driving force giving rise to a change in the internal information state. Although the external material is unchanging, it is to be emphasised that its use will be situation dependent." (Yovits et al, 1987: 409)

According to Yovits et al, to *know* means that the DM has already incorporated in his information state the knowledge contained in external documentation. To learn means that the DM is incorporating in his information state the knowledge contained in external documentation (Yovits et al, 1987: 418).

There is a commonality of intent in the two equations, and this commonality is to do with internal cognitions, recognised as an assumption of the user-oriented paradigm of Dervin & Nilan (1986). Like Brookes' equation, the equation of Yovits et al highlights the inward shaping of what people already know by external information that is available to them. Both equations acknowledge that what is going on in a person's mind shapes the way information is interpreted and utilised. Both highlight information utilisation in terms of a process of cognitive change; and both assert the need and importance of the field to examine this core idea of cognitive change.

Brookes' ideas were also similar to those of MacKay (1969). In proposing a nomenclature of information theory, MacKay asserted that information theory was concerned with the problem of measuring changes in knowledge, based on the notion that when people received information, it caused a change in the symbolic picture or representation which people would use to depict what they know. He posed two key questions: To what does information make a difference? and What are its effects?

> "Information makes a difference to what we believe to be the case. It is always information about something. Its effect is to change, in one way or another, the total of 'all that is the case' for us. ... "We may define information in general as that which justifies representational activity. ... The effect of information is a change in

a representational construct. Information may be defined in the most general sense as that which adds to a representation" (MacKay, 1969: 158, 162-3).

MacKay's concerns about knowledge representation, change and effects are similar to those of Brookes. While Brookes spoke in terms of "modification", MacKay described it metaphorically as "the recipient of a message as causing a change in the 'lever setting' of the brain" (MacKay, 1969, 23). What MacKay endeavoured to do that Brookes acknowledged as too difficult, however, was to suggest an approach to measuring the changes. He proposed a "Structural Information-Content", a numerical index of the "size" of the representation itself, or a numerical index of the complexity of the construction-process, built around units called Logon and Metron (MacKay, 1969:162-3).

2.9.2 The components of the Equation

Brookes' Fundamental Equation is made up of three conceptual parts: information, knowledge structure, and modified knowledge structure. The first point to be noted is the variation in expression of the Fundamental Equation and these components by Brookes. His writings reflect several versions of the equation, over the time of his writing:

$\Delta I = (S + \Delta S) - (S)$	(Brookes, 1975a: 48)
$\Delta I + S \rightarrow (S + \Delta S)$	(Brookes, 1974:147)
$\Delta f(I,S) + (S) \rightarrow (S + \Delta S)$	(Brookes, 1974: 148)
$I + K \rightarrow (K')$	(Brookes, 1975b: 116)
$\Delta I \rightarrow K(S + \Delta S) - K(S)$	(Brookes, 1979: 253)
$K[S] + \Delta I = K[S + \Delta S]$	(Brookes, 1980a: 131)

While the expressions of the equation are different, the tenor of the equations is not: ΔI or I is the information input which modifies the knowledge structure' (S) or K(S) or K to $(S + \Delta S)$ or $K[S + \Delta S]$. In developing the version of $\Delta f(I,S) + (S) \rightarrow (S + \Delta S)$, Brookes argued that it is possible to observe the information inputs in terms of physical signals, but in the final stage of the process the physical signals are transduced into private interpretations or thoughts which are themselves functions of the individual (S). Thus in writing $\Delta I = \Delta f(I,S)$ the equation becomes $\Delta f(I,S) + (S) \rightarrow (S + \Delta S)$. In other words, the information inputs are transduced into private thoughts which are a

function of the individual, and these private thoughts modify the knowledge structure. This idea is elaborated later in this chapter. Whatever version, Brookes claimed "crudely interpreted, it says that whatever 'goes' in depends on what is already 'there'. The private world of subjective knowledge is literally *meta*-physical" (Brookes, 1974: 148).

Brookes was seemingly unconcerned about mathematicians' interpretation of the equation, particularly the use of the mathematical symbols = and +. He acknowledged the equation as an "oversimple formulation with all its symbols undefined" (Brookes, 1980d: 253). However, understanding what is meant by the symbols =, + and -> in the various equations, at least in general terms, is considered important as it helps clarify the nature of the relationships between the concepts. Brookes did not address the mathematical ramifications of the equals (=) sign, nor his substitution of -> for = in some versions. The equation was posited as a general equation, and Brookes and other writers, for example Belkin (1990) acknowledged that the terms, including the operators were ill defined, circular, and depended on one another. According to Neill, the undefined "+" in the equation "contained an entire discipline" (Neill, 1982: 36).

At first glance, the + sign suggests addition. In considering the notion of addition embodied in this symbol Brookes stated:

> "The absorption of information into a knowledge structure may cause not simply an addition but some adjustment to the structure such as a change in the relations linking two or more concepts already admitted" (Brookes, 1980a: 131).

It is important to understand that Brookes talked about information creating a change, a modification, an effect, and not simply an increase in or addition to knowledge as is assumed in much of the discourse about information. He saw the growth of knowledge as some adjustment to the structure, such as a change in the relations already linking two or more concepts already there. Information, selectively chosen from the multitude of sense impressions that individuals are exposed to, makes a difference to what already exists. Brookes also acknowledged that the same information ΔI may have different effects on the different knowledge structures. The adjustment of knowledge structure through information is governed by perceptions, attitudes, values, dimension of situation, that is elements of people's situated reality or frames

of reference. This notion fits with the cognitive viewpoint that an individual's prior knowledge and experience will influence how he or she perceives, comprehends and remembers new information.

On first consideration, the = sign suggests that what goes in must come out; that all information that a person is exposed to is integrated into a knowledge structure and still retains its pre-integration characteristics, whatever they are. This is the assumption of equality. This is not an appropriate interpretation, and is illustrated by Brookes' designation of ΔI and ΔS on either side of the equation. Brookes did not assume equality, rather, he assumed a difference, and this is brought out in his discussion, albeit limited, of modification and change as "effects". Brookes spoke clearly of equilibrium, rather than equality:

> "A knowledge structure must be regarded as a live information-seeking ('emmorphotropic') entity striving always to modify itself to be in dynamic equilibrium with the information it is receiving. Some of the incoming information adds nothing new to what we already know; the corresponding parts of the structure are strengthened but not consciously. Some of the information may be new and help to resolve some anomaly or reduce some stress in the structure; such information is of interest and we may become conscious of it" (Brookes, 1978: 22).

Brookes also claimed that the Fundamental Equation could also be considered as a sequence. Each successive information inputs I_1, I_2 ... In in sequence changes the person's knowledge structure from $(S)_0$ to $(S)_1$, from $(S)_1$ to $(S)_2$ and so on, corresponding to the successive inputs.

$I_1 + (S)_0 \dashrightarrow (S)_1$
$I_2 + (S)_1 \dashrightarrow (S)_2$
$In + (S)_{n-1} \dashrightarrow (S)_n$
The overall sum of these sequences is:
$\Sigma I + (S)_0 \dashrightarrow (S)_n$ (Brookes, 1974: 148)

The equation sequence suggests that knowledge (S) is a structured entity that evolves by the accretion and integration of many increments of information over different exposures to information at different times. It is a dynamic, ever changing entity. Brookes thus regarded this equation only as

a skeleton, and in stating that the interpretation of the equation is the basic research task of information science, he saw the major task of information science was to "put flesh on its bones by analysing examples of knowledge structures and by observing how they respond to information received" (Brookes, 1975a: 117). In doing so, Brookes claimed that this could be done by describing precisely the state of knowledge of a reader at the beginning of his reading, but also recognised that the reader would already have a complex knowledge structure (Brookes, 1974: 148). So Brookes asked: where does one begin? He answered it by stating that "here is no beginning in the sense in which the equation requires" (Brookes, 1974: 149).

According to Brookes, from the moment of fertilisation, the inherited genetic program takes over, cells divide and new structures develop in continuous development. This growth, wholly genetic and biochemical and gradually becoming sensory then cognitive, is a continuous information process. And through the continuous interaction of these processes, the structure and mechanisms of some form of (S) emerges (Brookes, 1974: 148). This notion of a continuous and dynamic information process underpins his view of information and knowledge and their interrelationships. This notion is consistent with current thinking on information utilisation as interactive change process, as established in Section 2.3. These concepts will now be explored in depth.

2.10 THE NATURE OF INFORMATION ΔI

Brookes believed that information surrounds people everywhere; that all is information. He claimed that the "seemingly empty space around us is seething with potential information" (Brookes, 1980a: 132). This idea has been echoed many times since in the information science literature. For example, Schrader more recently made the claim that "the millennium of theory might easily be realised if only the LIS community would accept the manifest truth that 'information' is synonymous with life itself" (In Frohmann, 1992: 366).

What is evident in Brookes' writing is his yearning for a theory of information science that speaks about information in the voice of natural science. In 1976, Brookes proposed that the pursuit of problems thrown up by information transfer and exchange required the development of a new

paradigm which was biological rather than physical, and that the problems of information science were cognitive as well as physical (Brookes, 1976: 104). He proposed that the continuous spectrum of "information processes which spring from the evolution of life on Earth" (Brookes, 1975b: 127) involved physical, biological and cognitive elements, and ultimately resulted in "objective knowledge". Like Schrader, he asserted that "In this wide sense of information, life is a continuous information process in which physical, genetic, sensory, and cognitive components all act together" (Brookes, 1975a: 49).

Brookes elaborated his understanding of what information was through these physical, genetic, sensory, and cognitive components. In defining information as "that which mediates all our interactions between ourselves and between each of us and our environment" (Brookes, 1978: 28), Brookes took a wide view of information and claimed we should be prepared to consider the wider uses of the term information before we commit ourselves to research on any fundamental theory (Brookes, 1975a: 46). He saw that this was essential to opening information science to free and critical scientific discussion. While acknowledging Shannon's idea of source, channel and destination, he rejected Shannon's model of information, claiming that it was non-cognitive because it assumed that the coding and decoding of the messages were exactly inverse processes, and that it was concerned with the storage and transmission of information, rather than creating an effect. In addition, he saw that it presented a notion of passive receivers of information from external sources, and where input was the same as output. There is a parallel here to conceptions of information utilisation as end-state. An examination of the physical, biological and cognitive components of information, and their holistic integration as an information process, follows. This provides the basis for conceptualising and operationalising "information" in this study.

2.10.1 Physical information

According to Brookes, all human communication processes rested on transmission of purely physical signals, patterns of sound or light or some other form of electromagnetic transmission, and could be observed by radiated or reflected signals:

> "All information reaches our brains by means of physical channels and physical processes. ... finally presented to us in forms acceptable to our sensory neural systems when we are ready to attend to it. Up to the point at which we become consciously aware of it, all this information through all its changes of mode can be traced and described in purely physical terms" (Brookes, 1978: 22).

Brookes did not accept that there was a realm of ideas wholly independent of a biological and physical basis and that what ever people knew was human-made and fundamentally dependent on people's sensory apparatus which was in turn adapted to physical practicalities (Brookes, 1975a: 46).

Brookes claimed that information was transmitted in a variety of ways: by direct observation of our surroundings, by reading, by what others tell us, and by unconscious means. Sometimes it is consciously sought, sometimes imposed, but "any information we gain is the result of a process in which our neural system is activated by some source outside our brain" (Brookes, 1978: 21).

Brookes argued that the point at which people become conscious of the incoming physical information, selection occurred:

> "Information envelops us. Yet, to some degree, we can focus our attention on a particular source. ... We have to select from what is available to us .. We can take conscious note only of information which our sensory organs respond to, and that is only a fraction of the information which envelops us. ...I see no reason why what is learned by direct observation of the physical environment should not be regarded as *information* just as that which is learned by observing the marks on a document. Physical information is derived from direct observation of physical phenomena" (Brookes, 1978: 21). "Though we are not usually conscious of the absorption of information from our surroundings, it is an essential component of almost every human activity" (Brookes, 1974: 143).

Brookes also recognised the objects of Popper's World 3 as sources of physical information, claiming that the developments in writing and in speech have enabled humans to store information in devices external to their bodies, thus increasing their sensory horizons enormously. He regarded these stores as exosomatic brains, or the "social brain" (Brookes, 1975a: 47) whose memory and processing capacity could be increased indefinitely. However,

while he believed that information in this documentary sense was a very limited view of information, he believed it to be an important part of the information process. While documents today are considered the traditional domain of library and information science (Houser, 1986), Brookes believed that all that surrounded us was potentially information.

Brookes acknowledged that the senses play an important part in this process of selection. His concept of information has been built on sensory processes of people receiving signals through their nervous system, and mainly through the senses. He argued that the sensory organs were well adapted for discriminating receptions of physical signals from the environment, claiming that as open systems, people continually draw energy and materials from their environment to maintain themselves and develop; that people construct new physical structures within themselves, including structures of knowledge acquired about the environment, a knowledge enabling them, for example, to recognise, select, and capture food.

> "All information which reaches a human mind rests on the transmission of energy ... Information is the resultant of a comparison of patterns. ... Information has its own physical laws and it is the business of information science to discover and apply them" (Brookes, 1974: 143).

2.10.2 Biological and cognitive information

Brookes proposed that physical information, as input energy, would activate the body's neural systems, and the information signals would then be transmitted along its neural pathways, a process he equated with perception. The incoming stream or patterns, detected by the sensory organs, would then be transduced into electrical signals which pass from the sensory organs along neural pathways to the central nervous system. Brookes saw this phase of information processing as the biological phase, and the information now being biological rather than physical. He claimed that these signals may or may not be transduced once again into the signals that people recognise and interpret cognitively. Cognition, according to Brookes, was the mental awareness of any signals received and the resultant the subjective interpretation of these signals:

> "The information transmitted by physical signals is not itself physical; it is the patterning the conscious mind imposes on or abstracts from the signals it attends to. Information / knowledge is the essential indefinable entity of World 2, as basic to World 2 as matter / energy is to world 1" (Brookes, 1980d: 254).

He believed that all cognitive processes depended on the physical and biological substrata of sensory processes; that people received cognitive information through the sensory nervous system, mainly through vision, hearing, touch - neural mechanisms by which information was transmitted, sorted, and organised into knowledge by these mechanisms.

> "So information science must concern itself with the biological processes, instincts, and drives which affect the selection and the responsiveness of the human to the totality of information continually showered upon him. ... But sensory processes need some physical carrier, some form of physical energy which serves as the information channel to the sensory receptors and which carries within itself directional properties which the human learns to interpret. We cannot, therefore, wholly ignore the physical methods by which information is transmitted to, analysed by, and stored in humans" (Brookes, 1974: 141).

Brookes further argued that the cognitions people took note of were so closely bound to physical, genetic, and sensory phenomena that no coherent scientific theory of cognitive information per se was possible. On this basis, he saw the only possible role for information science in this arena might be to undertake the enormous task of attempting to integrate these studies around the central concept of information regarded as a process which is extended over the physical, biological and cognitive levels (Brookes, 1974: 149).

In summary, this overview of Brookes' view of information is important for this study for a number of reasons. In positing the transformation of information through physical, biological and cognitive stages, Brookes constantly affirmed people as active change agents in this selecting and transforming process. People are presented as active information processors who transform information in accordance with their unique model or image of the world. This study rests on this assumption. The overview also provides an approach to conceptualising what information is. In this study, the starting point for the physical - biological - cognitive information continuum is the provision of printed documents about the drug heroin to the girls. These printed

documents are derived from sources publicly available in libraries and information agencies. These sources, as records of people's knowledge, would be considered by Brookes to be "objective knowledge". The printed documents are the starting point of the sensory signals, and the basis of the selection process for each girl. While the study defines physical information in the narrow sense as sensory input from printed documents, it acknowledges that the environment of the research may be potentially another source of physical information for the girls.

As identified by Brookes, a selection process is an important assumption underpinning this research. It presents the girls as active, discriminating users of information rather than robotic information processors who absorb, like a sponge, all information that surrounds them. It does not assume that all of the information in the documents will be selected, nor does it assume that document provision will result directly in the girls being informed or benefiting without any intervening processing.

Brookes' information ΔI represents information in its cognitive phase. At a more concrete level, Brookes defined it as "a small bit of *knowledge*" (Brookes, 1980a: 131), as that bit which "*modifies* a knowledge structure in any way" (Brookes, 1978: 21). For the purposes of this study, ΔI thus represents the bits of information that the girls select from the totality of the physical information, in this case the printed documents which are used as the basis for information giving. These are the bits of information that they choose to attend to and to cognitively work with, and that are the basis for modifying their existing knowledge structures. The operationalisation of ΔI is elaborated in Section 2.13

2.10.3 Information in the wider context of information science

What is the standing of Brookes' view of information in the broader arena of information science? This is an important question for this study. It could be argued that the credibility of Brookes' Fundamental Equation as a workable framework is in part dependent on the acceptance of the meanings ascribed to the components of the framework in the broader arena of information science.

At the outset, it is realised that the question "what is information?" boasts an extensive literature, and is an elusive and controversial concept that reflects graduations and varieties of epistemological standpoints. Zhang has estimated that more than 400 definitions of information are presented by researchers from different fields and cultures (Zhang, 1988: 480). In this disparate and often ambiguous literature, Brookes' view of information and its modifications-oriented context is not a singular, isolated view. Pratt (1980) has indicated that Brookes belongs to the Information-as-Process school, which holds in general that when a person is exposed to some sort of input or signal, an internal change occurs within the individual. This change is more than the simple acceptance of the signal, rather, the message is accepted and integrated into the whole complex of the individual's present state of knowing and in the process of accepting the signals the internal complex is somehow modified or changed to a greater or lesser degree.

Pratt has also put forward a view of information that is conceptually similar to Brookes. Pratt posited information as an event that causes "inward forming", derived from the Latin origin of the world "informed". He described this internal complex representation in terms of "image", a term borrowed from Boulding (1956). The inward forming is the alteration of the Image which takes place when it receives a message. He also acknowledged that "the nature of this internal complex, and the nature of the changes which occur under different circumstances are not at all well understood" (Pratt, 1980: 31). Pratt proposed the term "emmorphosis", "the process of change within the human mind (or image) caused by the receipt and integration into the image of a structured message received directly or indirectly from some human source" (Pratt, 1980; 32).

Similarly, Debons (1992), Nitecki (1985), Belkin, Oddy & Brooks (1982) and Heilprin (1989) have elaborated views of information in the context of sensory data being received and integrated into existing knowing. Like Brookes, Debons did not separate information from human experience. Debons claimed that people perceive data when that data, in the form of energy or symbols, stimulate their senses. This exposure creates a state of consciousness or awareness, and at this point, people claim to have acquired information. People then respond to this information in a number of ways, such as storing it in their brains or jotting it down on a piece of paper. This

physical or cognitive representation of data about which people are aware is now considered information" (Debons, 1992: 213).

Nitecki, like Brookes, also supported the notion of a continuous information process. He defined information as "a cluster of perceptions brought to our attention, but not yet fully assimilated" (Nitecki, 1985: 388) and argued that information and knowledge were neither similar nor mutually exclusive autonomous concepts; but that, together, both were the components of information-knowledge processes that functioned to absorb new perceptions into an existing system of relations already known. Nitecki claimed:

> "the 'new' knowledge is always a result of an individual's own subjective series of information-knowledge processes, and not a product of some external, objective knowledge, unaltered and transmitted in toto from outside sources" (Nitecki, 1985: 388).

Heilprin's view (1989) is strikingly similar to that of Brookes. Like Brookes, he took the view that information was all pervasive, and identified dimensions of information that reflect Brookes' physical, biological and cognitive information. As a physicist and information scientist, he argued that energy was the sole "thing" in the universe, and information was a manifestation of energy. People became aware of their environments only if flows of energy stimulated their senses, the senses becoming the "ports of entry into the body". Through these waves of energy, an awareness of specific structure, labelled by Heilprin as "modulations", is conveyed. This input is then demodulated or transduced into an internal output, action currents of the body, assembled into the brain and stored in short- and long-term memory. Through cognitive processing that includes association, recall, abstraction, interaction, and decisioning, it is integrated into epistemological knowledge. In essence, modulation is the basis of information; it is transformed into information only in living systems; and it has enormous transformational complexity: "information is an organic product made and used in, and only in, a living body" (Heilprin, 1989, 367). On the basis of this argument, Heilprin concluded that information science was already a part of all the basic sciences - physical, biological and psychological. Like Brookes, he believed that the role of information science was to understand and map the entire trajectory of an information object to a mind, drawing on knowledge of the

scientific, technical and educational worlds, and that to do so would represent a major cognitive advance of humankind.

From a different perspective, Belkin, Oddy & Brooks (1982a) suggested that people engage in information seeking behaviours when

> "their states of knowledge concerning some particular situation or topic are recognised by them as somehow being insufficient or inadequate for that situation; that is, there are anomalies (gaps, uncertainties, lack of relation or concepts etc) in their conceptual state of knowledge concerning the topic, which they perceive as needing to be resolved in order to achieve their goals" (Belkin, Oddy & Brooks, 1982: 65).

Like Brookes, they also recognised that while information at times is consciously sought, and at other times is imposed, any information gained is the result of a process in which the neural system is activated by some source outside the brain, and that this incoming information is filtered through private knowledge structures.

As illustrated in the above examples, underpinning Brookes' Fundamental Equation as the conceptual framework of this study is a widely acknowledged view of information known as Information-as-Process. It is a holistic view encompassing physical, biological and cognitive dimensions. Yet at an operational level, this study deals with physical information in the form of printed documents, what Buckland has called Information-as-Thing (1991). The output of the cognitive and biological processes of this study are also physical, in the form of written discourse and audio recordings. It assumes that the physical information, as input, is transformed into biological and cognitive information, and transformed again as output into physical information.

2.11 THE NATURE OF KNOWLEDGE, AND THE RELATIONSHIP BETWEEN INFORMATION AND KNOWLEDGE

Brookes made a distinction between "knowledge" and "information", regarding both concepts as the fundamental entities of the cognitive world. He defined them in the following way: "knowledge is structured integrated

information and information is fragmented knowledge" (Brookes, 1981b: 4). He presented two dimensions of knowledge: internal private cognitive knowledge, and external public social knowledge. He established internal knowledge as the summative construction of cognitive information, selectively absorbed and ordered. As already established, he claimed that the multitude of sensory signals do not always evoke a discernible response; people do not attend cognitively to all the sensory inputs to which they are exposed. Rather, some are selected for special attention; these signals are interpreted, organised, and have patterns imposed upon them. According to Brookes, this is the acquisition of private, internal knowledge. However, Brookes recognised that people also create objective knowledge by expressing themselves in publicly observable ways which may attract the cognitive attention of other people (Brookes, 1974: 147).

According to Brookes, one crucial difference between information and knowledge is that knowledge is cognitively structured. Any bit of information in a knowledge structure is related cognitively through the structure to all other bits in the structure. These cognitive relationships are synthesised into a structure which, in spatial terms, may have any number of dimensions (Brookes, 1978: 23). The resulting structure is a coherent entity.

One important dimension of knowledge identified by Brookes was its dynamic, ever-evolving nature. He saw knowledge as constantly changing as it responds to the multitude of sensory stimuli, at the same time seeking to find an organised equilibrium:

> "Each of us has a private knowledge, more or less coherent. This private knowledge embraces our personal view of the world we inhabit, our social role in that world and any special expertise we may have acquired from our professional activities, from the playing of musical instruments or games or from the exercise of many other skills" We began with little knowledge. Our knowledge structures continue to grow, to change their form, perhaps to become more rigid (Brookes, 1978: 21).

In essence, Brookes saw a complementary relationship between information and knowledge in the information process continuum: "I regard knowledge as a structure of concepts linked by their relations and information as a small

part of such a structure"; a "summation of many bits of information which have been organised into some sort of coherent entity" (Brookes, 1975a: 48).

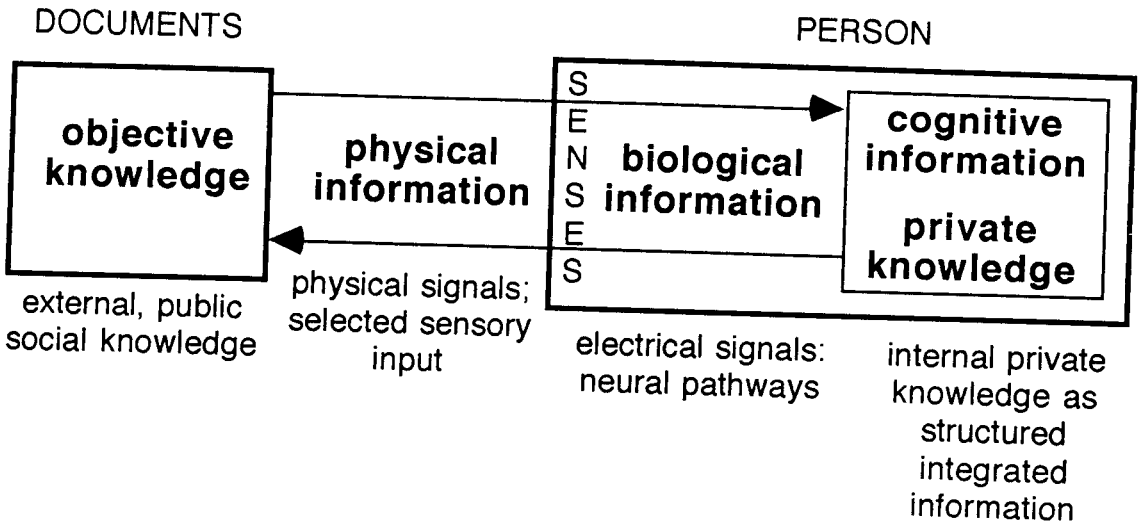
2.11.1 Knowledge in the wider context of information science

There are many views of knowledge, and Brookes' view can be placed alongside a range of similar views. Predating the bulk of the writing with a cognitive viewpoint, Mackay claimed: "we can regard knowledge thereof as providing us with *prior* or *structural* information" (1969: 178). Nitecki argued that information and knowledge were neither similar nor mutually exclusive autonomous concepts; but that, together, both were components of information-knowledge processes. He defined knowledge as a "a state, at any particular time, of relations known that are expressed in a system of knowing that has already been acquired by an individual" (Nitecki, 1985: 388). Nitecki identified three different levels of interpreting knowledge: a conceptual notion of knowledge that accepts a Platonic focus on the essence of things, ideas and forms, and the explanations of their meanings; a contextual notion that refers to specific knowledge in specific contexts where one becomes knowledgeable about things by an actual acquaintance with them, and by understanding their observable and causal relations; and an empirical notion of knowledge, described by reference to linguistic conventions and expressed in static symbols such as printed messages. In all cases, "knowledge is an idea, an abstraction, which is open-ended, constantly changing in terms of newly acquired understanding of relations among different aspects of reality" (Nitecki, 1985: 390). Similarly, Debons claimed "knowledge was that change in the total cognitive repertoire of the individual as a result of exposure to repeated stimulations from the external world" (Debons, 1992: 29) that can be measured in terms of changes of behaviour, such as in learning.

While the terminology is different, there is a consistent thread running through these conceptualisations of knowledge and their relationship to information. Conceptually, knowledge and information are the same kind of thing, though neither similar nor mutually exclusive. Knowledge is a collective entity, a summation, integration and transformation of many bits of information organised in a coherent way. It exists privately in the minds of people, and it can be made external and public though being recorded in some way. The

following model in Figure 3 summarises how Brookes perceived these relationships:

FIGURE 3
INFORMATION-KNOWLEDGE RELATIONSHIP: BROOKES



2.12 KNOWLEDGE STRUCTURES AND THEIR REPRESENTATION K[S]

The view of knowledge as a coherent entity embeds the notion of structure. Brookes, in characterising knowledge as "a structure of concepts linked by their relations" (Brookes, 1980a, 131), further postulated that as a result of an information process, these structural entities, called knowledge structures, could be modified by information ΔI to some effect, indicated by ΔS.

Brookes established two roles of knowledge structures as dynamic entities. The first role was to subjectively interpret sense data from the outside world, thereby transforming sense data into information. This role, not substantially addressed by Brookes, implies that people's exiting knowledge structures are an important, if not essential frame of reference in the information process, playing a critical role in the selection and rejection of the information inputs. The role of people's existing knowledge has also been identified in the information utilisation literature as an important frame of reference in people utilising information, and indeed, is a primary theoretical principle of the cognitive viewpoint. Belkin & Robertson (1976), for instance, asserted that existing knowledge structures control the perception and processing of external information. This study makes the initial assumption that the existing

knowledge structures of the girls will have some control on their selection and processing of external information, and identifies the importance of establishing existing knowledge structures prior to exposure to information.

The second role of knowledge structures as posited by Brookes was to integrate this information into the knowledge structure, thereby bringing about its own transformation (Brookes, 1980a: 131). He consistently asserted that the integration of this information was not additive, in a sense changing only the edges of the existing knowledge structure; rather, the integration of information was transformative, modifying the whole structure.

Consistent with his notions of public and private knowledge, Brookes identified two types of knowledge structures. These were "objective maps" of a body of knowing based on the exosomatic stores of knowledge; and "cognitive maps". Each of these knowledge structures will be discussed in turn. While Brookes' own application of his Fundamental Equation was explicated in terms of mapping public knowledge for reasons acknowledged previously, a discussion of his "objective maps" is presented, as it sheds light on methodological issues for this study.

2.12.1 Objective maps

Brookes viewed a single, public document as a "landscape" with a "limited perspective which distorts the objective distance". As an organised collection, he argued that while public knowledge may be objective, "it lies deeply immersed in the confused multiplicity of documentary landscapes" (Brookes, 1980d: 254). He claimed that a journal article or a book was a public, individual expression of some part of a person's private, inaccessible, though coherent) knowledge structure. In being public, it was accessible, but incoherent with elements in conflict, obsolete, redundant, scattered, and incomplete. He saw the need to transform these individual landscapes into objective "maps of human knowledge", which as cumulated, integrated and stable entities, could be regarded as both a database and also as a map of the current knowledge structure of a subject field.

While he was not fully clear on how these maps of human knowledge might be made, and regarded conventional indexing as an inappropriate tool, Brookes claimed that the most promising approach was the elaboration of

Farradane's relational indexing (Farradane, 1980a: 267-276; Farradane, 1980b: 313-324) to generate graphs of concepts and relationships, with elements coded by international agreement. Brookes' approach to the representation of these public knowledge structures was based on specifying concepts and their relations, and mapping these in a cumulative and integrated manner. He saw that over time, additions would enable observations to be made of the growth of new ideas. According to Brookes, this growth would take place through systematic comparison of knowledge structures and a process of checking and critiqueing:

> "the first representation of the structures would be simply graphic or diagrammatic. ... In the next representation the relationships will be replaced by notational forces acting on the concepts so that anomalies give rise to stresses in the structure" (Brookes, 1981a: 10).

He saw that this could be undertaken by computer technology. Then,

> "it will be possible to construct a network of concepts linked by relations specific to the field for selected compact sciences. Each such network would be a "map" showing the cognitive structure of the science, each fragment of information placed in its context. Such structures will be replicas, or near replicas, of the subjective cognitive structures of those contributing to the development of the science. But these maps will be visible" (Brookes, 1981a: 10).

This discussion is important to this study, in that it identifies a potential methodology based on Farradane's relational indexing for representing the knowledge structures of the girls in the sample. This is considered in depth in Chapter 3. Brookes' shift in focus to mapping public knowledge structures, based on an equation that is about people's private, internal knowledge structures, makes the assumption that the publicly observable growth of knowledge as recorded in the published literature reflects the ways in which individual minds think privately. In other words, the observable growth of recorded knowledge is the same as thinking and learning. This assumption has implications for this study. It raises the question of whether the recorded knowledge of the girls and its changes over the different exposures, acquired through the research procedures, is an adequate reflection of what they have done cognitively with the information. This is also examined in Chapter 3.

2.12.2 cognitive maps

As identified above, according to Brookes the primary difference between objective and subjective knowledge is related to the nature of their respective structures: external knowledge structures of the published literature are seen as public, accessible but incoherent, and an individual's knowledge structure, a cognitive map, is private, largely inaccessible but coherent. Brookes did not elaborate on what the dimensions of a private knowledge structure might be, except to say that it was an "n-dimensional structure composed of concepts and their interrelationships" (Brookes, 1978: 22). He speculated that when people communicate, the relevant parts of the knowledge structure are expressed in words and the n-dimensions are squeezed into a "linear verbal stream", and then linear processes such as sound waves transmit these words. Within the physical channels the information transmissions have no cognitive structure, but as the transmissions reach the mind of another, the stream of physical information filters through that person's n-dimensional knowledge structure and, in a successful communication, modifies that structure as the bits find "their proper place" (Brookes, 1978: 22-23).

Brookes raises here some important aspects that impact on the study's methodology, in addition to the adequacy concern raised above. He suggests first that it is possible to express a person's private knowledge structure as a linear verbal stream such as sentences and phrases. This has implications for approaches to elicitation and acquisition of the girls' knowledge, and how the knowledge is actually recorded. Secondly, he suggests that these linear verbal streams have their proper place, implying that they are not isolated streams, but linked as some kind of interrelated network. Establishing these linkages thus is an important component of accurately representing the knowledge structures of the girls.

Brookes acknowledged that to test these speculations about the development of private knowledge structures in any direct empirical way would be very difficult:

> "I cannot believe that it would be possible to make intrusive observations inside other minds without seriously affecting the phenomena we hope to observe. Nor can we rely on introspection. ... So the direct investigation of subjective

knowledge structures does not look any more promising now than it has done for many centuries" (Brookes, 1978: 22-23).

As stated in the introduction, to claim that it is possible to examine knowledge structures is not to challenge the intellectual integrity of Brookes. His comments predate significant advances in cognitive psychology, artificial intelligence, knowledge representation and information science that enable such investigations to be undertaken.

2.12.3 Other views of knowledge structure

As with his notions of knowledge and information, Brookes' considerations of knowledge structures are similarly reflected by other writers in the field. Given that Brookes did not elaborate an approach to operationalising people's private knowledge structures, a consideration of knowledge structures in the wider field particularly contributes to approaches to operationalising them. There is acceptance in the literature on information utilisation that an understanding of cognitive knowledge structures is seen as a theoretical basis for understanding how people know what they know, how what they know changes, how they use what they know in interaction, and how they understand the process of interaction. Any investigation of knowledge structures however must also acknowledge the research and development in the broader arena of knowledge representation. This field is multidisciplinary in character, and cuts across artificial intelligence, cognitive psychology, education, linguistics and information science. Some commonalities are identified here. Specific approaches to operationalising knowledge structures together with their theoretical underpinnings are dealt with in Chapter 3.

Ingwersen (1982) identifies a number of synonymous terms for knowledge structure: schemata, knowledge structures, frames, scripts, states of knowledge, and image, although he prefers to use knowledge structures. These terms, and others such as model, picture, plan, production, theme, memory organisation package, thematic abstraction unit, mental model, and knowledge store are often used interchangeably, and proponents of the cognitive viewpoint do not seem to advocate a particular structural representation (Belkin and Robertson, 1976: 203).

Frohmann defines structure as "a set of possibilities ... an achievement of the mind resulting from the mind's acting either upon the products of sense organs or upon its own mental accomplishments, a text, a textbook ..." (Frohmann, 1992: 371). Hashway & Hashway, like Brookes, make the distinction between internal and external structures, and acknowledge their interrelatedness: "a knowledge base is defined as a lexicon - a set of symbols representative of an internal representation of the external world" (Hashway & Hashway, 1990: 33). As representations, internal knowledge structures are the cognitive framework for selecting and organising information, and help to reduce the complexity of a given environmental context.

Ingwersen's definition is more concrete, and provides insights into operationalising knowledge structures. He defines knowledge structures as "the system of categories and concepts ... visualised as a battery of maps ... [which] may cover the same material, ordered according to various overriding concepts" (Ingwersen, 1982: 168). According to him, the central model "consists of a sensory organ, followed by a filter which sorts out that part of the extensive amount of information or data received by the senses which is allowed to pass to the processing in the short-term and long term memory" (Ingwersen, 1982: 170). In this system, certain stimuli, such as information, may activate a particular map, or part of the knowledge structure in the long term memory, on which the individual operates in the actual thought process. He claims each individual's image of the world consists of a conglomeration of different knowledge structures, the actual knowledge structures being the individual's view of the world (Ingwersen, 1984a). When a person's knowledge structures in a particular area of interest are considered incomplete or anomalous by that person, they are transformed into an Anomalous State of Knowledge (Ingwersen, 1982: 172).

Holzner & Fisher define knowledge structures as "bounded cultural entities", even though they are internally differentiated, they are structured in terms of some principle of coherence, and require some often very particular cognitive skills and orientations for entry (Holzner & Fisher, 1979: 230). As early as 1979 they asserted that investigation of specific knowledge structures and modes of discourse involved in knowledge utilisation contexts was needed both for the understanding of transfers and of knowledge transformations" (Holzner & Fisher, 1979: 230).

Graesser & Clark (1985) distinguish between specific and generic knowledge structures. The focus of their research is exploration of implicit knowledge, memory, recall, passage summarisation and the construction of knowledge structures during narrative prose comprehension, in order to develop a model of narrative prose comprehension. Generic knowledge structures are seen as general patterns of information that accrue in working memory: "structured summaries or abstractions of sets of exemplars" (Graesser & Clark, 1985: 32); "semiautonomous chunks of generic knowledge" (Graesser & Clark, 1985: 35), and are "a very rich configuration of information that contains a combination of taxonomic, goal-oriented, cause-oriented, implications and property substructures" (Graesser & Clark, 1985: 4). For example, the generic knowledge structure for "drugs" would embody general knowledge about drugs.

According to Graesser & Clark, a generic knowledge structure houses a large amount of knowledge that either always or sometimes occurs or exists during the experience, such as characters, properties of characters, setting, properties of settings, props, properties of props, intentional actions and unintentional events, methods of achieving goals, and rules of etiquette. They are created from many experiences with the concept in question. Each generic knowledge structure is not a prototype, that is, a single exemplar with a set of typical components being filled with typical values, rather they are broad conceptual, non linguistic entities corresponding to characters, objects, scripts, spatial regions, and other packages of generic knowledge. When a set of generic knowledge structures is activated during comprehension, the structures interact with each other in working memory. These generic knowledge structures, as declarative knowledge structures, "rub up against" each other. Construction mechanisms in working memory eventually converge on a set of knowledge-based inferences that are associated with a passage. Generic knowledge structures are intentional meaning structures which are not rooted in a contextually specific world.

Graesser & Clark illustrate a generic knowledge structure through the example of "kidnapping". A "kidnapping" generic knowledge structure houses a large amount of knowledge that either always or sometimes occurs / exists during kidnappings, such as characters, properties of characters, setting, properties of settings, props, properties of props, intentional actions and unintentional events, methods of achieving goals, and rules of etiquette.

They are created from many experiences with the concept in question. It is not a prototype, that is, a single exemplar with a set of typical components being filled with typical values (Graesser & Clark, 1985: 2-4).

On the other hand, according to Graesser & Clark, specific knowledge structures are bound to the specific world referents of the immediate, concrete experience. A specific knowledge structure is created from a specific experience or passage of information that is comprehended at a particular time and place (Graesser & Clark, 1985:3). A specific knowledge structure is thus generated in relation to a narrow domain of knowledge, and is based on a generic knowledge structure. A specific knowledge structure that embodies drugs is the structure that might be developed, for instance, when a specific person experiences the effect of a particular drug, or hears some information about the life of a drug addict on heroin.

These different viewpoints of knowledge structures have some commonalities. There is general acceptance that people's private knowledge is organised in cognitive structures, and that a knowledge structure is a highly complex network, and unique to each individual. There is some acceptance that a cognitive structure is an organised network set of facts, concepts, and generalisations a person has about a subject, a sort of cognitive aboutness; that it contains cognitive contents organised in some way that are the result of cognitive processes. These cognitive structures also facilitate access to the contents. There is also acceptance of the notion that no single cognitive structure represents all the knowledge of a person.

Graesser & Clark's investigation is particularly relevant to this study, as they provide both an approach to operationalising knowledge structures, and empirical data based on this operationalisation. In their operationalisation, the basic components of knowledge structures are knowledge units called statement nodes, and a system of relations links knowledge units together in an associative manner. This approach underpins this study, and is elaborated fully in Chapter 3, together with its theoretical underpinnings and justification.

2.13 THE UNIT OF KNOWLEDGE IN A KNOWLEDGE STRUCTURE

The preceding review suggests a general acceptance of the notion that knowledge structures are units of organised knowledge that people have in their minds about the world for every situation. The level of representation, in terms of semantic network, schema or mental model is a more procedural decision. The critical question at this point is understanding at a theoretical level what actually is in the unit of knowledge in a knowledge structure. The debate on the content of knowledge structures is wide ranging, and is dependent on epistemological viewpoints and contexts. A number of specific functional taxonomies, distinguishing between forms of knowledge, types of knowledge use, bases for validating knowledge, and sources of knowledge have been developed in a number of disciplines.

The information utilisation field gives some emphasis to the procedural versus declarative knowledge debate, where knowledge is primarily "knowing how", that is, knowing procedures for the use of knowledge, and "knowing that", that is, a list of domain specific facts and general inference procedures which reason about them. In addition, conditional knowledge, entailing the understanding of when and where to access certain facts or employ particular procedures, is also identified as a form of domain-specific knowledge (Alexander & Judy, 1988). This debate gathered particular momentum in the 1970s, and has generated a number of procedural type representations. There is acceptance that declarative knowledge tends to be accessible, and can easily be examined and combined with other declarative statements to form inferences and to establish relationships. There is also the recognition that procedural knowledge tends to be more inaccessible, being used to guide actions, and that it is difficult to elicit and acquire, on the basis that people seem to have conscious access to declarative knowledge, but do not have this access to procedural knowledge.

Brookes posited the unit of knowledge in a knowledge structure as declarative knowledge. He identified it as a "bit of information" (Brookes, 1980a: 131); a message that is a description of phenomena (Brookes, 1978: 24); and a "concept" (Brookes, 1980a: 131). Without clarification, Brookes has assumed that the unit of knowledge is concept based. The concept structure of knowledge is founded on Ausubel's assimilation theory of

cognitive learning (Ausubel, 1963). This theory asserts that a concept, as a mental representation of a category of a group of people, things, events or ideas, plays a central role in the acquisition and utilisation of knowledge, and that new knowledge and meaningful learning result when a person consciously and explicitly ties new knowledge to relevant concepts and propositions already possessed. It asserts thus that concepts, and propositions composed of concepts - Brookes' "verbal streams" - are the central elements in the structure of knowledge. Concept meanings are developed primarily in the extent that they are embedded in frameworks of propositions, and that the set of propositions a person has incorporating a given concept defines that person's idiosyncratic meaning for that concept. Concepts thus do not have fixed meanings, but rather meanings derived from the matrix of propositions in which they are embedded. The work of Ausubel has been a pervasive force in education for many decades.

2.14 KNOWLEDGE STRUCTURES RESEARCH

The information utilisation research does not address the question of changes in people's knowledge structures; there is no discussion of how information utilisation as a cognitive effect might be evidenced in changes to people's knowledge structures. Indeed, the wider areas of knowledge representation and information science provide only limited discussion of both the measurement and characterisation of changes in a person's knowledge structure, and effects. This is particularly evident in Allen's review (1991) of cognitive research in information science. He argued that while a great range of research across many disciplines has been undertaken in many aspects of memory, cognition, text comprehension, and domains of knowledge, this work appears to be quite fragmented and disparate, and does not provide a cumulative body of knowledge about the dynamic nature of knowledge representation. Some representational activity has dealt with the comprehension of texts; some has explored the role of knowledge representation; some has examined knowledge representation in terms of the learning process. A selective analysis of this research is useful in that it provides some approaches to conceptualising the effects of information on existing knowledge. This analysis will highlight some of the key ideas emerging in the literature that are linked to changing knowledge structures.

2.14.1 Cognitive change strategies

There is some limited research and discussion in terms of the cognitive strategies of change operating on knowledge structures. Given that identifying such change strategies is an important stage of the data analysis of this study, it is appropriate to consider this aspect. Brookes stated: "the absorption of information into a knowledge structure may cause not simply an addition but some adjustment to the structure such as a change in the relation linking two or more concepts already admitted" (Brookes, 1980a: 131). In this statement, Brookes conceptualised changes in people's knowledge structure in terms of adjustments to how concepts in a person's body of knowledge are interrelated. Essentially he identified two strategies of structural change, addition and adjustment, although there was no further elaboration as to their character, or how these might be observed.

Pratt (1982) distinguished between a complex cognitive structure as one that consists of many, fully integrated dimensions, and a simple cognitive structure which consists of few, partially integrated dimensions. The distinction between the two appears to be one of number of nodes and relations, and patterns of linkages. While the notions of simple and complex provide a potential approach to examining changes through counting nodes and relations, they provide no clear framework for conceptualising these changes, nor articulate the cognitive strategies that underpin them.

Kintsch & Van Dijk (1978) explored semantic structure of texts in the context of comprehension and inferencing processes. They identified two levels of knowledge structure: microstructure, the structure of individual proposition and relations at the local level of discourse; and macrostructure, a more global structure characterising large blocks of discourse. In addition, they provided three macro rules in the process of development of a knowledge structure which embed the idea of structural change. These strategies focused on the process of reducing and organising microstructures into macrostructures:

1. *deletion:* removal of ideas
2. *construction:* substitution and inclusion of ideas
3. *generalisation:* condensing the full meaning of a passage into its gist. (Kintsch & Van Dijk, 1978: 366)

Nebel (1991), in an exploration of syntax-based approaches to belief revision and default reasoning, identified three operations of integration of information, in the context of incorporating new information into a knowledge base while preserving consistency. Belief revision, in the context of his study, was viewed as the process of updating one's state of belief with newly received information. These operations reflect Brookes' notions of addition and adjustment, and introduce the notion of deletion. The operations identified were:

1. *expansion:* addition of x to structure A: A + x
2. *contraction:* removal of information x from structure A: A - x
3. *revision:* a process of modification (not elaborated)
(Nebel, 1991: 417-418)

Katsuno & Mendelzon (1991) identified two kinds of conceptual modifications to a knowledge base, one taking place at the micro level, the other at the macro level. They were:

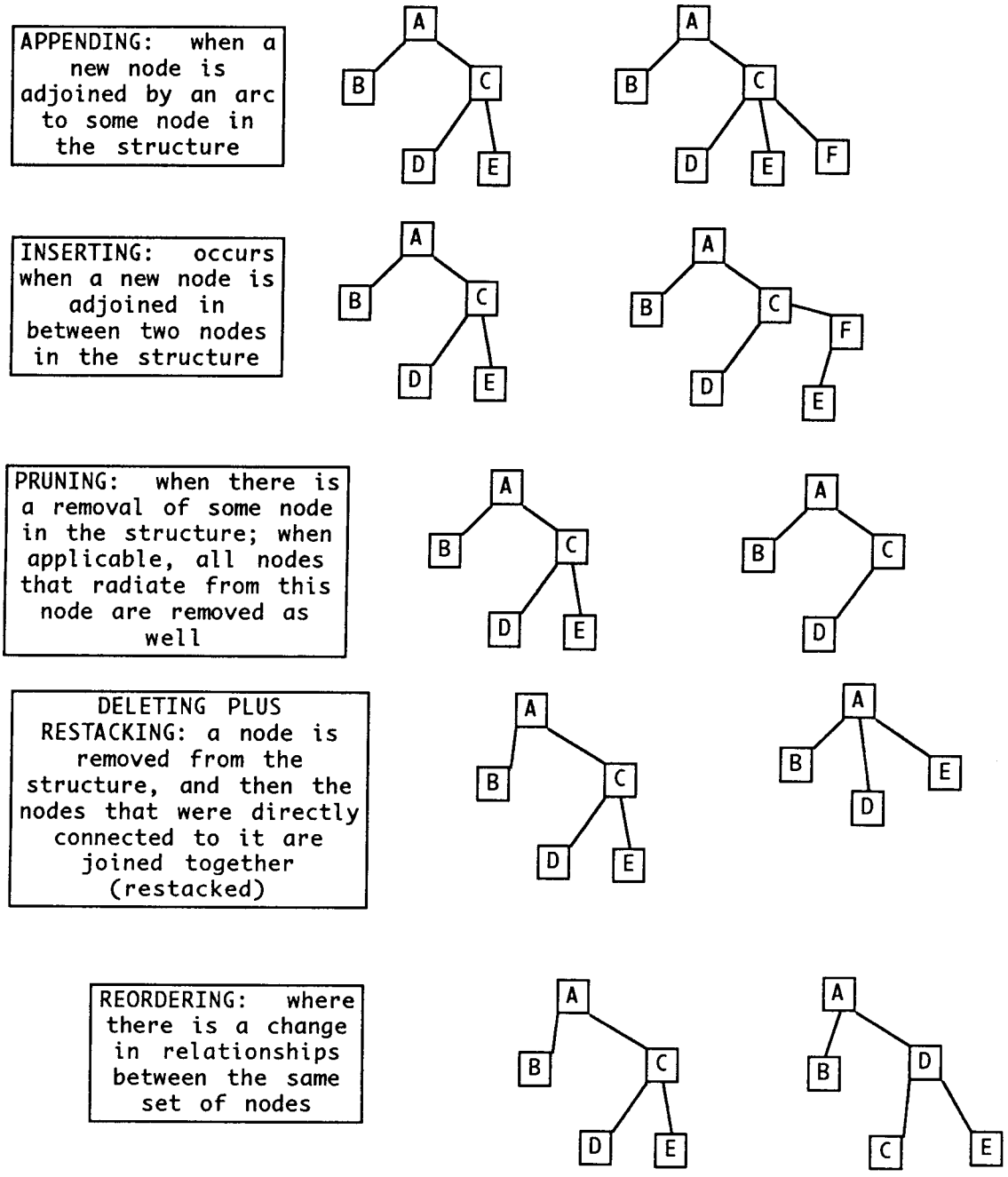
1. *update:* change-recording updates, focusing on local behaviours, where the knowledge base is brought up to date when the world described by it changes. These local updates involve addition and erasure, and

2. *revision:* when we are obtaining new information about a static world, operating at a more global level. This has two processes, similar to those at the local level, which are adding new knowledge that supersedes the inconsistency, and contraction, that is, removing contradictory knowledge. Contraction is the loss of confidence in some idea or proposition; the act of giving up a belief. The new information casts doubt, identified it as incorrect, and we contract the corresponding proposition from our knowledge base. (Katsuno & Mendelzon, 1991: 387)

Graesser (1981), in a structural-conceptual analysis of comprehension processes and how graph structures were constructed during the course of comprehending a passage, identified five ways that a structure "S" could be transformed to structure "S'" after an additional statement was

comprehended. The following diagram provides conceptual definitions, and shows how these were observed in the actual structure. In this diagram, A, B, C, D, E, F indicate a unit of knowledge, a node, and the lines indicate relations.

FIGURE 4
COGNITIVE CHANGE STRATEGIES: GRAESSER



(Graesser, 1981: 250)

The range of cognitive strategies identified here show a number of differences, particularly in relation to how concretely or abstractly they are conceived, as well as in terms of their completeness of coverage. However, the approaches also share some commonalities. Firstly, there appears to be a number of generic strategies that transform a knowledge structure, these being addition, deletion, and adjoining. Secondly, there appears to be some loose consensus of the effects or outcomes in terms of revisions, updates, and extensions.

The field of education provides some theoretical conceptualisations of changes in knowledge through its extensive literature on the nature, process and outcomes of learning. This literature is useful for this study, in that the experimental conditions of the study simulate a high school learning environment. It is argued that the process of learning, particularly in a school context, is all about information utilisation as it has been broadly defined in this study. Learning is directed to bringing about changes and growth in people's knowledge, skills, attitudes and values. This learning takes place through continual exposure to information, and through classroom activities designed to foster the takeup and integration of this new information to some learning outcome or effect, generally measured through examination and continuous assessment. Learning assumes that knowledge is not static and changes in form and content, and this takes place over time.

The development of knowledge structures over time is often referred in the educational literature as cognitive development. Cognitive development is seen to involve the ongoing processing of new information in accordance with prior knowledge. Because of the processing, prior knowledge structures are transformed into new, better integrated versions. One predominant model of cognitive development is the Piaget model. According to this model, when new information is received, it is related to prior knowledge through four cognitive development processes:

1. *assimilation,* which occurs when new information is related to pre-existing structures of understanding;

2. *accommodation,* the development of new structures of understanding in response to new information;

3. *organisation,* the processes that maintain knowledge in an organised form;

4. *equilibration,* the ongoing process that maintains knowledge in a coherent and consistent form. (Piaget, 1971)

These conceptualisations however, do not provide the level of granularity required in this study. Piaget's model of conceptual change is more global and formal than a more local view of individuals' conceptions which this study hopes to explore.

2.14.2 Time, semantic relatedness, and other concepts

The impact of time on the nature and extent of the cognitive dimension of information utilisation, particularly in relation to knowledge structures is unknown. Brookes' Fundamental Equation, as a sequence, is a sequence in time. However, few studies of information utilisation have a longitudinal component and have collected data on utilisation at more than one point in time (Larsen, 1976; Larsen 1985; Rich, 1975). These studies have concluded that information utilisation takes time; that there are systematic shifts in types of information utilisation over time; and that the constantly emerging process transforms the terms of the interaction as it goes along. Larsen (1985) claimed that time provides a benchmark against which to note patterns of utilisation, and that it can also be a causal factor. The context of these studies, however, was information utilisation as organisational impacts, and examined changes over time at a more macro level. The actual investigation of these interactions along the lines of Brookes' equation, however, is very limited. Researchers seem to agree that regardless of the character of outside variables, what actually happens in the individual cognitive process of information utilisation, at any time, and over time, is open to great variation.

Another concept in relation to knowledge structures and time is that of semantic relatedness. This appears to be one of the most powerful and reproducible principles in the field of semantic memory to date. The basic idea is that semantic relatedness controls the time required to compare concepts. This idea is variously labelled in the multidisciplinary literature as semantic distance, category dominance, production frequency, and typicality.

Essentially it states that when two items are semantically close, people classify them "same" more quickly than "different". For semantically distant items, the reverse is true (Rosch & Mervis 1975). This raises a procedural implication for the study related to the provision of adequate time to enable processing of the information. This is addressed in Chapter 3.6.8.

In the educational research on knowledge structures, a number of common concepts have been developed that relate to characterising changes in knowledge structures. These are potentially useful for this study, given that it seeks to establish patterns within and between people in relation to changed knowledge structures and perceived effects. These concepts include coherence, structural centrality, inferencing, and typicality. Some of these concepts are also found in the information utilisation literature. For instance, Larsen & Agarwala-Rogers (1977) in describing the way in which an innovation is changed during the process of implementation provides an approach to measuring the degree of change on a number of dimensions. The study took place in community mental health centres, and investigated variables in the consultation process that contributed to information provided by the consultant. To measure utilisation, the observer kept a careful record of recommendations and suggestions made by the consultant, and these were followed through after two months and four months. The study found that reinvention occurs with considerable frequency. Changes were conceptualised in terms of:

1. *fidelity:* the degree to which elements of an innovation are implemented by the receiver in the form introduced by the source;

2. *modification:* the degree to which the adopters of an innovation change the original innovation other than by adding new elements;

3. *expansion:* the degree to which the adopters of an innovation add supplemental elements to the original innovation;

4. *extent:* the degree to which innovations are implemented by the receiver;

5. *flexibility:* the degree to which the innovation can be readily continued or discontinued one it is introduced;

6. *complexity:* the degree to which implementation of an innovation requires a variety of resources; and

7. *specificity:* the degree to which components of an innovation are outlined in detail. (Larsen & Agarwala-Rogers, 1977: 137)

Studies by Chi and associates [Chi & Koeske (1983); Gobbo and Chi (1986); and Chi, Hutchinson & Robin, (1989)] have focused on the way in which experts' and novices' representations of a small, simple and confined domain of knowledge could be structurally differentiated. The studies focus on two representational characteristics of structural centrality, that is, coherence and hierarchy. While the present study is not exploring differences between the knowledge structures of novices and experts, these studies are important in that they provide insights into conceptualising differences in knowledge structures as a result of exposure to information, as well as identifying important properties of knowledge structures.

Coherence refers to both the integratedness of the whole structure, called "global coherence", and the integratedness of the substructures that form the hierarchy called "local coherence" (Chi, Hutchinson & Robin, 1989: 29). Global coherence refers to the presence of a clear hierarchical organisation. They postulate that two sets of identical concepts and attributes in a knowledge structure can have different degrees of local and global coherence simply by the way the concepts are linked. One structure may be "more structured" than another. Local coherence of the sub-structures can be defined in terms of patterns of interlinkages and attribute-sharing among concepts, and hierarchy (or global coherence) in terms of the pattern of relationships among substructures. A substructure may be more locally coherent in the sense that pairs of concepts share attributes to a greater degree than other pairs of concepts in another substructure. The studies collected data to investigate the notion that knowledge structure may be defined in term of coherence and hierarchy. They collected data from children aged 5 to 7 in terms of their knowledge about dinosaurs. Evidence of global coherence was gleaned from the existence of multiple links among target dinosaurs within the same family, in conjunction with only single links between target dinosaurs from different families. Evidence of local coherence was determined by the extent to which dinosaurs of the same family share attributes.

The studies showed that patterns of linkages for lesser known dinosaurs was more diffuse and less differentiated. As knowledge became more detailed and more comprehensive, the knowledge structures showed more local and global coherence. Experts' dinosaur concepts appeared to be more interrelated, that is, showed greater structural centrality, and more differentiated than those of novices. The study concluded that experts' representations were more locally coherent, more integrated and more differentiated than the novices' representation. Generally no differences were detected between experts and novices on the total number of propositions produced and the number of conceptual clusters created. Experts based their sorting on well-defined schemata of family types, whereas novices tended to sort on the basis of visual similarity. The study also suggested that background knowledge per se can enable expert children to learn new domain-related concepts more readily, despite the fact that both groups have the same fundamental learning skills. Over all the three studies, significant differences were found in the way experts' and novices' representations of a small, simple and confined domain of knowledge was structured. Structure of experts' knowledge was more coherent both locally and hierarchically. Local structures of experts were better defined than novices, as could be seen by the number of links between concepts within the same family and the sharing of features among family members.

Another key concept associated with knowledge structures is inferencing. The literature is extensive, particularly in the area of language studies and reading processes. The field is far from settled, and the problem of inference generation continues to provoke a great deal of debate. In the field of psychology, for example, there is still widespread disagreement about what, when, how and why inferences are generated, and what knowledge sources contribute to the generation of inferences (Graesser & Clark, 1985). It is not the purpose of this study to explore inference generation. However, probing inferences in the acquisition of a person's knowledge base is an important aspect of the knowledge acquisition phase of the study in order to provide a sufficiently rich knowledge base for the workability of this study, and to establish the linkages between ideas.

Frederiksen's work of the 1970s is also important conceptually to this study. His studies focused on the effect of task-induced cognitive operations involved in "complex ideational learning" (Frederiksen, 1972: 211). His

research (Frederiksen, 1972, 1975a, 1975b, 1975c) was based on a model of knowledge structure that involves three unified components:

1. units or elements of semantic content which are the objects of operations in comprehension and memory; smallest such element is "concept" that is "the intersection of a set of component semantic features";

2. relation defined on two or more concepts, and which may be defined in a number of ways: - action, order, complexity; and

3. implication: a transitive relation linking two or more propositions.

He used this model to investigate the effects of structure and of other variables upon integration of information from text which people have read and whose structure was previously modelled. To assess acquired knowledge, Frederiksen developed a procedure for coding a person's verbal reconstruction of knowledge acquired from a presented text against the logical and semantic structure from which text was derived. Comparison data was collected from people asked to retell or record the narrative stories. Underpinning his research were the assumptions that information processing takes time, and that there are limitations on processing capacity. At a general level, his studies asked to what extent does a person's knowledge structure correspond to surface feature of text, and to what extent are generated elements transformations and / or distortions of what is contained in the text. The method used was to ask subjects to reconstruct the content of a presented text, then to code the conceptual and relational information of the output, based on the semantic model, and to examine sources, text, context, prior knowledge. The results indicated that the experimental context did impact on amount of inferred and overgeneralised semantic information in subjects' text recalls. Elaborative responses decreased with repeated exposures; derived information was retained to a greater extent than was reproduced information over time. The amount of derived material increased with repeated exposures to text and information was reduced and overgeneralised.

Based on his studies, Frederiksen (1975b) proposed two models of text processing for further testing. These were:

1. *interpretative model* - semantically processing each input sentence in its entirety, where the structure of the text is replicated somewhat in the representation of the knowledge structure; and

2. *constructivist model* - selective processing of input integrated with contextual information and stored knowledge to generate a semantic interpretation which fits the input data. This model suggests that comprehension involves using prior knowledge, intention, context and task demands in combination with input structure to control discourse processing. The constructivist model predicts that contexts ought to have pronounced effect on text processing, and that this would be evident in the semantic representations.

The above studies show that there are diverse approaches to conceptualising changes in knowledge structures. The different disciplinary perspectives, different research contexts, and different research methodologies have resulted in often overlapping, if not competing, conceptualisations of change. This diversity however, provides this study with a loose framework for undertaking the analysis of the changes in structure, and a starting point for developing meaningful constructs for the changes.

2.15 CONCLUSION

The preceding analysis highlights a number of aspects which shape the scope, purpose, and approach of this study. Much of the information utilisation research is based on the assumption of means preceding the attainment of ends, with a resultant focus on observing and measuring external behaviours, actions and outcomes that characterise the end of the informing process. The existing literature does not extensively examine what happens cognitively when people are exposed to, and work with information, and what are the effects of this process. Rather, in tending to portray information utilisation mechanistically, it tends to mask the complex cognitive processes that occur, and what these processes mean in terms of information utilisation. In much of the information utilisation research, people play a passive role as mere reactive receivers of information. Few information utilisation studies have characterised people in the initial stages of the information utilisation process, though many studies make elusive

connections between information acquisition and utilisation. This study is positioned in this acknowledged gap. It seeks to directly tap into information utilisation at the point in time when it is occurring, to examine its cognitive dimensions, and from the perspective of the girls involved.

Based on the analysis of cognitive information utilisation in information science to date, Brookes' Fundamental Equation is a sound framework for the study. It provides some clear boundaries and directions for undertaking the study. The equation makes sense. It asserts that when people purposefully select information from the multitude of sense impressions that they encounter in their daily lives, and integrate this into their existing private knowledge, it can make a difference to what they already know. It asserts that the cognitive process of doing something with selected information has a cognitive effect. This effect is in essence cognitive information utilisation. A cognitive change takes place. Existing private knowledge, organised as a structured, integrated and coherent entity, is transformed by this information, creating a new knowledge structure. This modification is a continually evolving process, as new information is continually selected and integrated. What people do cognitively with information thus may be demonstrated in a transformed knowledge structure, as well as other perceived effects.

In the analysis of Brookes' Fundamental Equation as a framework for understanding cognitive information utilisation, little is know about the aspect of cognitive change. The equation raises several important questions that are central to the identified gap: What are the perceived cognitive effects when people are exposed to information?; How do people's knowledge structures change when they are exposed to information? and How are these perceived effects associated with changes to people's knowledge structures? These questions form the basis of this research.

Brookes' Fundamental Equation, and the extant literature surrounding this equation, provide conceptual definitions of key concepts underpinning the study - knowledge, information, knowledge structures, and effects, as well as some guidelines for operationalising these. It also helps to clarify some operational assumptions underpinning the research. These will be elaborated further in Chapter 3.

CHAPTER 3

METHODOLOGY OF THE STUDY

3.1 INTRODUCTION AND AIMS OF THE RESEARCH

This chapter addresses the methodology of the study, and is in two parts. The first part discusses the methodological underpinnings and issues that have shaped decisions related to the methodology and aspects of the data analysis. These include the choice and justification of research design, issues related to the sample, current perspectives on knowledge elicitation and acquisition, and an overview of theoretical approaches to knowledge representation. The second part of this chapter presents the chronology of implementation of the research design. This part documents decisions about the limitations of the study, sample, experimental conditions, focus problem, ethical issues, procedures plan, operationalisations, pilot study, steps in the data collection procedure, and procedures related to knowledge representation.

The central concept of this study is cognitive information utilisation, and the conceptual framework underpinning its examination is Brookes' Fundamental Equation. In the context of this equation, the study seeks to:

(a) *establish the effects ΔS of exposure to information perceived by the girls;*

(b) *establish how the perceived effects are associated with changes to their knowledge structures $K[S]$;*

and, on the basis of (a) and (b)

(c) *establish the patterns, if any, within and between the girls in relation to changes in knowledge structures and perceived effects $K[S + \Delta S]$.*

The research aims suggest a number of methodological requirements. These are:

1. operationalising knowledge structures by establishing procedures for eliciting and acquiring knowledge from the girls and then representing this knowledge as a structure (Chapter 3.5);

2. operationalising exposures to information (Chapter 3.6.7);

3. establishing an analytical process for identifying the perceived effects of the exposures to information (Chapter 4.3); and

4. establishing an analytical process for elaborating the changes to knowledge structures (Chapter 4.4; 4.5).

PART 1 METHODOLOGICAL UNDERPINNINGS AND ISSUES

3.2 THEORETICAL CONSIDERATIONS OF RESEARCH DESIGN

A number of theoretical considerations which have influenced design, operational and procedural decisions are elaborated first.

3.2.1 Choice of research methodology

Over the last decade the social science disciplines have witnessed an explosion in qualitative, interpretive approaches to studying people where the research act is seen as "an instance of interpretive, symbolic interaction. ... Interacting individuals produce and define their own definitions of situations" (Denzin, 1989: vii, 5). This study reflects a number of features of a qualitative approach, consistent with the user-oriented assumptions identified in Chapter 1.1. However, this study cannot be placed at either one or the other end of the continuum of qualitative or quantitative approaches to research as it draws on aspects of both. These features are:

1. *an emphasis on understanding cognitive information utilisation from the point of view of the participants in it.* While the data collection is through

a quasi-experimental approach as discussed in Section 3.2.2, the approach to data analysis is qualitative in order to identify the girls' conceptions of cognitive information utilisation.

2. *a focus on the development of concepts of cognitive information utilisation, and their relationships to knowledge structures.* The concern of this study is elaboration and interpretation of concepts, seeking new understanding in a field that is characterised by richness, complexity and ambiguity, rather than the confirmation of well established theories. Blumer refers to this approach as "lifting of the veils" by "getting close to the area and digging deep into it through careful study" (Blumer, 1977: 38). This study makes the assumption that social science research is progressive, continually searching for understanding in which tentative answers lead to a refinement of the questions to which they apply; and that there is no final answer, and no final solution.

3. *interpreting the data on the effects and changes to knowledge structures from the perspective of the girls.* The analysis is presented for the most part in narrative rather than numerical form: "fundamentally, qualitative researchers seek to preserve the form and content of human behavior and to analyze its qualities, rather than subject itself to mathematical or other formal transformations" (Lindlof, 1995).

4. *transferability and application beyond the girls studied are tentative.* The well-grounded, thick description and explorations however provide a strong basis for further hypothesis development and empirical examination, and for others to make judgements about the credibility of the research and transferability of its findings to their own contexts and situations.

3.2.2 Quasi-experimental approach

This study employs a quasi-experimental approach to collect the data, rather than a naturalistic context characteristic of many qualitative studies. While some elements of an experimental design have been introduced into the setting of the research, full experimental control is lacking, hence its designation as quasi-experimental. The girls have not been selected randomly, there are no control and treatment groups, and a small number of

girls is used. The study retains some fidelity to the real world environment whilst simultaneously allowing for some control of the researcher's observations. The choice of this approach is set within a broader understanding of the perceived weaknesses and strengths of available methods, and against the current status of information utilisation research established in the literature review. This is briefly discussed in the following section.

As established in Chapter 2, information utilisation research has relied on a case study approach or on surveys involving questionnaires, naturalistic observations, content analysis, path analysis and personal interviews, where respondents described the details of the information they used, and impact scores assigned. A case study approach was carefully considered as a potential approach to data collection for a number of reasons. These included:

1. they are an accepted approach for investigating information utilisation;

2. they are acknowledged as being particularly appropriate to investigating events when the boundaries between phenomenon and context are not clearly evident;

3. they have the advantage of the researcher not controlling the data collection environment nor confined by a data gathering instrument; and

4. their flexibility and adaptability facilitate in-depth investigation beyond what can be accomplished by statistical analysis alone, enabling more use to be made of nonquantified material and qualitative data than other methods.

Given the user-centred assumptions underpinning this study, it is acknowledged that situating the research in the natural setting where the phenomenon occurs is ideal, and that a quasi-experimental approach might be seen to compromise this. However, a case study approach was seen to present a number of limitations, also acknowledged in the information utilisation literature (Larsen, 1980; Rich, 1991;Wingens, 1990). These limitations include:

1. *the multitude of uncontrolled factors, particularly in relation to frames of reference.* These factors make interpretation difficult. In order to advance conceptually our understanding of cognitive information utilisation, it was felt that a study with some control of frames of reference would be an appropriate starting point.

2. *inadequate definition and description of variables under study.* These have made many studies difficult to replicate, let alone contribute to a cumulative body of knowledge about the concepts in question.

3. *the absence of detailed discussion of research methods, characteristics of groups and analytic categories in many studies.* The absence of these aspects make it difficult to assess the credibility of the research and the findings and inferences reported, and the transferability of the findings to other contexts.

4. *the problems of memory recall and lack of awareness of cases of non-utilisation.* These have been rarely acknowledged.

5. *the problems of classification.* The classifications of conceptual and instrumental utilisation currently established through case studies do not appear to capture the complexity of utilisation as a construct, let alone its complexity as a cognitive construct.

6. *the problem of partiality.* Research bias and loss of objectivity in case studies have not been substantially addressed in information utilisation research. In case studies, it may be easy for researchers to let their subjective feelings intrude on the data collection, and this weakness may be of sufficient magnitude to destroy the main reason of the study. In this study, it is important that the perspective of the girls be clearly established.

The decision to employ quasi-experimental approach was made to address some of these concerns. It is recognised that experimental and quasi-experimental approaches to data collection are relatively uncommon in the information utilisation literature, and in the broader area of information seeking behaviour. Information utilisation research is very context-specific and the view is openly expressed, for example, by Larsen (1981) that the

classic laboratory approach is not appropriate for the study of conceptual utilisation or utilisation for enlightenment because it requires unrealistic simplifications for understanding complex phenomenon affecting information utilisation. In contrast, Mandell (1989) claims that while information utilisation research has been dominated by surveys and interviews, there is a need to use a variety of research approaches whose strengths and weaknesses complement, rather than reproduce, one another. He claims that much research relies on, or is implicitly constructed on rational models of decision making where decisions are easily identifiable discrete entities, and acknowledges that little research focuses on decisions that are shaped as a series of gradual and amorphous steps (Mandell, 1989).

It is recognised that observing what goes on inside a person's head does not readily lend itself to naturalistic observations, and that subjective, unobtrusive measures may not capture sufficient of the knowledge structures of participants. This has been a major consideration in the choice of the research approach. Data triangulation was initially considered as a possible solution to these limitations (Greene & McClintock, 1985). However, it was not considered appropriate because observing knowledge structures employing a variety of data collection methods is not only difficult to do, but also because the application of a range of methods to achieve triangulation may change the knowledge structures, thus muddying the outcome. Indeed, while Brookes was sceptical of peering into other people's minds, he did suggest that there was a need for:

> "experimental or observational knowledge structures and information inputs. We then have to observe what happens, measuring the effects as well as we can, at first in simple cases and then in more complex cases as we develop skill on our technique and confidence in our theories." (Brookes, 1975a: 48).

A quasi-experimental approach was seen to offer a number of other advantages, given the purpose and specific aims of the study. Experimental approaches are acknowledged as strong designs for establishing new concepts and identifying possible hypotheses for further research. Dunn, Dukes & Cahill commented that while an experiment is a sheltered and questionably representative environment, "it has the decided advantage of permitting deep and reasonably well controlled probes into processes of knowledge creation, diffusion and utilisation" (Dunn, Dukes & Cahill, 1984:

396). They argued that this advantage is particularly important in a field where complex cognitive processes were often oversimplified and taken for granted, and particularly where real-world observation was difficult.

Coursey also argued that experiments were useful for studying expected-effect conceptions of information utilisation, and were particularly advantageous in understanding knowledge from a conceptual focus: "Carefully controlled conditions with individual subjects are highly desirable in evaluating how humans process knowledge" (Coursey, 1989: 234). These arguments are particularly relevant to this study, given the absence of well-established theory, the focus on understanding concepts of cognitive information utilisation, and the acknowledged difficulty of being able to "peer into other people's minds" (Brookes, 1974: 149).

A carefully controlled design was seen to provide the advantage of a systematic approach to establishing and refining conceptual categories, and discovering associations among phenomena. This is at the heart of this study. It is recognised that experiments tend to simplify reality where influences are pervasive and uncontrolled by eliminating many of the extraneous and contextual factors as possible, and thus do not emulate real world contexts. However, the specific and relative contributions of many environmental variables are difficult to determine in field studies or case studies. This is particularly relevant to this study, given the evidence of the range of frames of reference that appear to shape the utilisation process. As established in Chapter 2, there is wide agreement of the notion that an individual's behaviour is a function of a multiplicity of factors. The information utilisation literature suggests that many factors influence information utilisation, and that behavioural variability is enormous. Given the complexities of the human environment, the possible causes of differences are likely to be numerous. The absence of *a priori* hypotheses in relation to cognitive information utilisation makes it difficult to know where to begin to factor out the multiple unidentifiable sources of variability. Since variability begins with one person differing in response to others, a logical starting point is the individual.

3.2.3 Justification of design

The most obvious limitation of a quasi-experimental approach is that one does not know if the findings from the study will be applicable to other cases. But as Cronbach once claimed: "the goal of our work ... is not to amass generalizations atop which a theoretical tower can some day be erected" (Cronbach, in Peshkin, 1993: 26); rather, it was "to describe as accurately as possible the status of contemporary fact" (Wehlage, in Peshkin, 1993: 26). These ideas underpin the primary purpose of this study, that is, to provide a richer understanding of concepts of cognitive information utilisation. A number of strategies have been put in place in this study to deal with the limitations commonly identified with experimental approaches. The setting of the research has been made fairly realistic to emulate a real world. The experimental conditions have been set up to approximate a part of the girls' natural environment. There was also a pretest and pilot study to elicit comments about the realism of the approach. These are discussed in Section 3.6.8.

The study however, does also aim for credibility, dependability and confirmability (Guba & Lincoln, 1989). These are seen as important qualities in establishing the overall trustworthiness of the research, and important in terms of comparability and transferability of findings. A number of strategies have been put in place to build these qualities, and to ensure that comparisons can be done confidently (Erlandson et al, 1993; LeCompte & Goetz, 1982; Guba & Lincoln, 1989; Peshkin, 1993). These include:

1. *careful delineation of the sample, how it was chosen and its characteristics.* This was seen important in terms of the study's comparability.

2. *careful delineation of assumptions, constructs, definitions, units of analysis, and controls that have enabled the researcher to manipulate and measure processes with precision of measurement, and detailed specification of the context in which data are gathered.* This is all about the provision of thick description. This was considered to be an important strategy for establishing the degree of transferability of the findings of this study. While it is acknowledged that the burden of proof for claimed transferability is on the receiver and not the researcher, this

study has endeavoured to provide extensive and careful description of the variables, time, place, context, analysis, and interim findings in order to facilitate transferability judgements on the part of others who may wish to apply this research to their own situations. The detailed explication and publicness of the methodology also facilitates replication of this study. These features enable other researchers to judge whether the methodology is adequate and makes sense, whether to use the same methods, and whether to apply the findings.

3. *ensuring the stability of the data over time.* The data collection procedure for this study is time consuming, and the potential for instability to occur because of boredom, exhaustion, or stress from the intensity of the process has been recognised. Built into the data collection procedures were refreshment and rest breaks. In addition, no alterations were made to the methodology during the week of data collection, and the specific procedures remained consistent for all the girls. The whole methodology is documented in detail, enabling others to examine the process, judge the decisions that were made, and draw conclusions about the dependability of the study.

4. *emphasis on explicating a systematic approach to establishing and refining the conceptual categories and the nature of their associations.* This is important to ensuring the match between the realities expressed by respondents and those realities as represented conceptually by the researcher and attributed to the respondents. The dual approaches to knowledge elicitation and the debriefing sessions provided opportunities for persistent observation, not only adding depth to the scope of the observations, but also enabling some verification of the emerging ideas. The knowledge elicitation methods employed provided the girls with a chance to correct errors of interpretation, thus enhancing credibility of the study. By detailing in depth the data analysis process, this study also addresses the criterion of confirmability. This is concerned with assuring that data interpretations and outcomes of inquiries are rooted in contexts and people apart from the researcher, and are not simply a figment of the researcher's imagination. The provision of specific examples ensures that conceptual constructs can be tracked to their sources, and that the inductive logic used to generate the constructs is explicit in the narrative. This was also seen important to

ensuring that all conceptual constructs are sought out and honoured - a fairness issue that contributes to the authenticity of the research.

The specific detail of these strategies is elaborated in Part 2 of this chapter, and further in Chapter 4 dealing with data analysis. It ensures the whole process has been carried out with integrity. Collectively this specificity also ensures that there is sufficient detail for others to make judgements about the transferability of the findings to their own situations and contexts, and ensures that other studies can replicate this study so that meaningful comparisons can be undertaken. Such detail may persuade or influence others to accept the trustworthiness of this study, though these features will not necessarily compel others to accept the findings of the study.

3.2.4 Phases of the quasi-experimental approach

Given that the focus of this study is on an indepth analysis of what people do when they are successively exposed to information, an important aspect of the procedure is the repeated observations. The quasi-experimental approach involves two phases. The first (A Phase) is the baseline observations of the girls' existing knowledge about the drug heroin. The second (B Phase) is where the exposure of information is introduced and changes or not noted by observing again the girls' existing knowledge. These phases are repeated, with no variation of the procedure. The repeating of the AB phase gives an AB AB AB ... design. Denzin has labelled this approach formally as "Same-group Recurrent-time-series Survey without Comparison Groups" (Denzin, 1989: 143-144). This approach is consistent with the conceptual framework of Brookes' Fundamental Equation as a sequence. It is unlikely that a history event will be timed to occur simultaneously each time the procedure is switched to the intervention phase, given the short time period of the study.

3.2.5 Sampling issues

In selecting participants, there were several possible approaches open. It was decided that it would be more advantageous to follow a small group of people and look at the nature of individual variability as well as cross-case variability. It was felt that working in depth with a small number of people and gathering thick data would permit the development of concepts and an

understanding of concept relationships grounded in the subjectively meaningful experiences of the persons being studied. In addition, it would help to identify and contain other factors that may be contributing to the process. Borg & Gall (1983) have suggested that a study that probes deeply into characteristics of a small sample often provides more knowledge than a study that attacks some problem by collecting only shallow information on a large sample.

Associated with this were also the practical problems of establishing a sample which controlled for important frames of reference. This would have involved a process of extensively matching the many relevant frames of reference, such as information seeking behaviours, attitudes, existing knowledge, and situational constraints. This was not feasible in the context of a doctoral dissertation. It was felt that even if a relatively large, homogeneous sample was feasible, when people were brought together in broadly defined categories, individual meaningful descriptions could be lost and easily obscured in dominant group patterns. Such patterns, while broadly characterising a group, do not necessarily represent the performance of any individual in a group, and the details of this individuality could possibly be lost. Thus it was felt that a detailed investigation of a small number of people was at least as informative as a superficial analysis of many people. The small group also raises implications for the transferability of the findings, particularly in terms of the perceived value of the findings derived from a small group when applied to a much larger group. The strategies documented above are also relevant to making transferability judgements about the small sample of the study.

3.3 THEORETICAL CONCERNS IN THE ACQUISITION AND REPRESENTATION OF KNOWLEDGE

The approach to operationalising knowledge structures involves consideration of two questions: how is knowledge acquired? and, how is knowledge to be represented? These two aspects will be addressed in the context of current theoretical frameworks. While it might be seen as more appropriate to examine these theoretical considerations in Chapter 2, they are relevant to decisions about methodology and procedures rather than on the substantive matters of content, and are thus considered here.

3.3.1 Approaches to knowledge elicitation and acquisition

Knowledge elicitation and acquisition refer to the processes of describing and writing down in a formal and useable way the knowledge of the subject domain under consideration that is known by a person. It is a process whereby knowledge is externalised from a person and the implicit relations between the ideas made explicit, and recorded in some way. Its purpose is to provide a set of ideas which represent the person's declarative knowledge of the subject domain.

The literature presents inconsistent advice about approaches to knowledge elicitation and acquisition, acknowledging incomplete theory and limited repertoire of approaches. From the perspective of cognitive science, Hoffman (1978), Gordon (1992) and Belkin, Brooks and Daniels (1987) have identified a number of typical ways in which information is commonly acquired for knowledge representation purposes. These include:

1. unstructured interviews as the most common approach, based on more or less spontaneous questions of how, what, when, where and why;

2. structured interviews;

3. familiar-task methods, which is a verbal analysis of tasks performed and methods used to make decisions;

4. limited information tasks, where limited information is given and reasoning processes examined for useful insights;

5. constrained processing tasks, where respondents work under time pressure or other artificial constraints to provide insights into reasoning processes;

6. tough-cases methods, based in analysing how experts solve difficult problems; and

7. observation studies where behaviour is observed and recorded as people work on real problems in their normal working environment, and in as unobtrusive ways as possible.

The focus of the cognitive perspective is on eliciting and acquiring the private, subjective information of an individual. Most of the approaches to do this, as identified above, focus on verbalisations, either written or spoken. The cognitive perspective assumes that the changes that take place during the reception of information can be measured by analysing the linguistic manifestations caused by these changes. In other words, there is a strong relation between cognition and discourse, where discourse functions as a lens through which changes to current cognitive states can be observed and measured.

The appropriateness of the cognition-discourse assumptions has been challenged by Talja (1996) and Tuominen & Savolainen (1996). For instance, Tuominen & Savolainen argue that "there is little to warrant the traditional claim that specimens of language furnish accurate or transparent indications of the internal world" (Tuominen & Savolainen, 1996: 5). They present information utilisation as constructive and functional, oriented to action. Underpinning this social constructivist perspective are the notions that the primary human reality is persons in conversation, and that language use, through talking and writing, produces our social reality. Discourse is constructive in itself, constructed to accomplish social action, rather than to express individuals' underlying cognitive states. On this basis Tuominen & Savolainen consider it inappropriate to treat written and verbal accounts as transparent indicators of inner mental events. Rather, they see information utilisation as a communicative construct which is produced in a social context, and the way in which a version of information is constructed always depends on the interactive or argumentative context of talk, as well as on the pragmatic social purposes this version is designed to accomplish. Consequently, they suggest focusing on analysing conversations, seen broadly as all kinds of public social interaction involving other people, and analysing how these are played out in action.

Talja (1996) is also critical of the cognitive viewpoint, similarly claiming that its central weakness is that it pays little attention to social aspects of information processes. She argues, like Tuominen & Savolainen, that an emphasis on people's cognitive processes and subjective knowledge structures removes an individual's subjectivity from collective reality; that the world and its objects are not constituted and defined in individual cognition, but are constructions that have been created in social interaction (Talja, 1996: 5). Talja proposes a

discourse analytic approach which stresses that the variety in knowledge structures is not caused by differences in individual interpretations; rather, they are intersubjective, produced within a shared social context.

These perspectives are appropriate if the focus is on what happens "in-between" not "inside" people (Tuominen & Savolainen, 1996: 9). They do not address, for instance, the issue of learning as something that happen within an individual; indeed, the assessment of learning that goes on in schools for many decades has been predicated on "specimens of language" in order to "furnish accurate or transparent indications of the internal world"; they do not address the notion of how individual knowing is changed in the first place by the social context. In other words, what a person knows subjectively, when constrained by the social context, may not be what a person actually expresses or acts upon. In the context of this study, their approach seems to be more appropriate in face-to-face situations such as debates, group negotiations, and meetings where the processual negotiation of meaning between people and the change in their knowledge can be investigated.

Not withstanding the theoretical perspectives, the major weakness of all the elicitation approaches is their time consuming nature, a consequence of the exacting, indepth nature of the analysis. This is also acknowledged in the literature (Hoffman, 1978). The "inside" people approaches also rely on intuition, introspection, experience and memory, raising dependability and credibility issues.

The selection of the most appropriate approach to elicitation and acquisition in this study was based on a number of considerations, notwithstanding the above considerations. Belkin, Brooks and Daniels (1987) claim that whatever approach is used, it should elicit knowledge at the level of granularity required for the particular application. It was important in this study to acquire a set of sufficiently indepth and rich expressions in order for the methodology to be workable. This meant considerations of nature of the task set, the nature of the information exposure and the likely processing time involved, the potential duration of the process; the physical and intellectual capabilities of the girls; and environmental limitations, such as availability of the girls in terms of the block of time required to complete the process. Current thinking also tends towards employing multiple approaches in order to expose a richer base of expressions.

Given these parameters, two approaches were chosen to elicit the knowledge of the girls. These were free generation written discourse, and question answering protocols through a semi-structured interview. These are probably the most popular methods for exposing and analysing the content of a person's knowledge. Graesser & Clark's review (1985) of these approaches indicate they have been used by researchers to acquire an extensive range of knowledge structures to do with objects, artefacts, plants, animals, technical devices and equipment, environmental scenes and regions, personality traits, roles, situations, routines, and person-situation combinations. Their research employing these approaches also provides evidence to suggest that the combination of these two approaches are a very informative first step in uncovering and exploring the content of a particular knowledge base.

Verbal protocols, in the form of think aloud protocols, question answering protocols, question asking protocols, and recall protocols have often been used to explore tasks and mechanisms involved in knowledge domains. There is some debate that question answering protocols are not valid indices of knowledge, based on the argument that the act of articulating knowledge interrupts or changes the normal course of comprehension, and thus the flow and content of the ideas. This does not appear to be supported by empirical research. The same complaint could be raised about all procedures. It has also been argued that verbal protocols are distorted because individuals express information in protocols which otherwise might not be constructed during normal comprehension. A more common argument is that both approaches are incomplete because they only tap knowledge that can be expressed in language. To some extent, all these arguments are correct. Research by Olson, Duffy & Mack (1984) has indicated that much of the respondent's knowledge can be expressed in language even though language cannot penetrate all of the knowledge. Graesser (1981) and Graesser, Robertson & Anderson (1981) have provided evidence to suggest that respondents do not generate fabrications and false information when they are probed with question-answer protocols. The choice of written discourse and verbal protocols as data collection measures was also made because these approaches are typical in the setting of this research, that is, schools, and the girls are likely to be familiar with these methods for gathering information.

All measures suffer potential problems. A destructive implication is that such data are meaningless and untrustworthy, so they should be ignored. In acknowledging these limitations, the approaches used in this study appear sufficient to acquire an extensive base of expressions to ensure the workability and soundness of the research.

The decision was also made to implement the data collection procedures with minimum instructions to the girls. This decision was based on empirical evidence of Allen (1990). His study sought to examine the effect of different kinds of instructions on people's knowledge of a topic, in the context of an information retrieval task. The findings showed that the different levels of instructions produced differences in the notes, with the free instructions producing the greatest length of notes (by word count) and richest data.

The present study acknowledges that any elicitation approach is constrained by a number of factors:

1. there are capacity limitations in short term working memory, as identified in the information overload literature (Todd, 1992); and

2. information processing takes time. Graesser & Clark claimed that "processing times are products of procedures and knowledge structures which determine the existence and parameters of the processes" (Graesser & Clark, 1985: 12).

Memory capacity and time have implications for the amount of information provided in each exposure, for readibility of the printed information, as well as for the overall length of the data gathering process. These factors were also important in the choice of knowledge acquisition approaches. They were also important issues to be dealt with in the pilot study, documented in Section 3.3.7.

Regoczei and Hirst (1992) identified three stages of knowledge acquisition. These stages formed the framework for the procedures set in place to acquire and represent the girls' knowledge in this research:

1. *elicitation*: eliciting expressions of a respondent's knowledge as a creation, not a discovery;

2. *explication*: refining, organising and validating the elaboration; and

3. *formalisation*: writing down the knowledge in a useable form to serve the purposes of the activity.

These stages are elaborated in Section 3.6.9.

3.3.2 Constructing representations of knowledge

The question of how a person's knowledge structure is represented is critical to resolving how knowledge structures will be observed in this study. The theoretical literature on knowledge representation identifies an extensive number of approaches to representing knowledge as a structure. A brief review of these approaches to representation and their theoretical frameworks is presented here, as well as a consideration of their suitability for the present study.

A considerable amount has been written in many disciplines about knowledge structures. The various theoretical and operational approaches for knowledge representation do not exist in isolation, rather, they rely explicitly or implicitly on various philosophical and epistemological assumptions about the world, and analyse knowledge with respect to an underlying set of basic structures and mechanisms out of which more complex representations can be constructed. New theories continue to be presented. For example, Way (1991) suggests that the cognitive mechanisms involved in metaphor may prove to be a better paradigm for structuring knowledge than logic-language and semantic approaches.

The disciplinary areas of information science, linguistics, education, and artificial intelligence have contributed a substantial, though varied theoretic input to the knowledge representation field. All of these disciplines overlap in that they are concerned with information processing, information representation, information assimilation, and memory. The problem of the representation of knowledge is a central issue in study of memory and cognition as a whole, indeed, representation has become one of its most muddled concepts. A detailed survey of these disciplines for the purpose of this research is not the intent given its focus on information utilisation and not

knowledge representation per se, nor is it a reasonable endeavour with so much going on in so many disparate areas.

Knowledge representation in information science draws on a body of linguistic and psychological theory primarily from the discipline of cognitive psychology, with a considerable amount of experimental work centring on the formulation of information processing models of the brain as a representation system (Belkin, 1976). MacKay asserted that information theory in general was concerned with the making of representations, that is, symbolism in its most general sense (MacKay, 1969: 161). Brookes, as already established, was not just concerned about the effective and efficient transfer of desired information from the exosomatic store to the user, but also with modelling the effect of information, and with the development of methods for modelling states of knowledge and information in compatible formats. In a similar vein, Belkin argued: "information science must be able to represent the information content of texts, and the state of knowledge of the recipient, in order to solve its problems" (Belkin, 1976: 35-36).

While many cognitive scientists take the concept of representation to be central, there is enormous debate concerning the precise nature of the representation. Key questions are: What is a representation? Is there only one kind? How is the information organised in a representation of knowledge? How can the representation be observed? Knowledge representation is interested in how to break down the vast pool of what is known in such a way that it can be formalised.

MacKay defined representation as:

> "any structure (pattern, picture, model) whether abstract or concrete, of which the features purport to symbolise or correspond in some sense with those of some other structure. ... For any given structure there may be several equivalent representations, defined as such through possessing certain abstract features in common. ... It is these abstract features of representations which are of interest in Information Theory" (MacKay, 1969: 161).

The notion of correspondence identified by MacKay is also central to Rumelhart & Norman's definition:

> "something that stands for something else ... it is a kind of model of the thing it represents" but highlight the need to distinguish between a "representing world" and a "represented world" (Rumelhart & Norman, 1985: 16).

They asserted that the most important thing about a representation was that it allowed reaching conclusions about the thing being represented by looking only at the representing world. This is an important assumption in this study. They argued that the representing world must somehow mirror some aspects of the represented world. This implies the need to understand what the represented world is; what the representing world is; what aspects of the represented world are being modelled; what aspects of the representing world are doing the modelling; and what the correspondences are between the two worlds.

3.3.3 Assumptions of knowledge representation

A number of key assumptions underpin knowledge representation and are embedded in this study:

1. subjective, private knowledge can be adequately modelled by representational systems;

2. humans handle complexity by finding patterns and grouping things into categories and units;

3. knowledge about a single state or event is organised together in one functional unit, that is, an associative nature of knowledge as knowledge "units" or "packages";

4. information known for one unit can be applied to other units, and inconsistent knowledge can exist;

5. the representation of the knowledge structures and a description of the processes which operate on those structures can be specified. This implies a representation notation and mapping procedure.

The literature on knowledge representation also questions the usefulness of representational measures. Way (1991) for example has questioned their

practical utility, even though they might be of theoretical interest. She claimed it was not clear what had been accomplished once they were constructed; that their utility in terms of psychological research had yet to be demonstrated, suggesting that the absence of concrete results or operating systems based on these models was an argument against their usefulness. While it is acknowledged that much basic research needs to be done before theories can be applied, acknowledging and testing the potential of approaches to represent knowledge is an important step forward.

3.3.4 Network models of representation of knowledge

Rumelhart & Norman (1985) have identified three general types of models of knowledge representation: the not widely used set-theoretic models, feature or category comparison models, and network models. The network model of the structure of knowledge has become a very pervasive concept in cognitive science, and today there is widespread acceptance that knowledge is organised in people's minds as a network of memory components composed of a set of nodes and links that contain contents that are the result of cognitive processes. There is also general agreement that no single structure represents all the knowledge of a person (Rumelhart & Norman, 1985; Nagle et al, 1992; Way, 1991).

Many network models have been proposed, with various underlying philosophies and basic principles. These models present theoretical conceptions of what the basic unit, a knowledge structure, is, and how these units are organised in the mind. At a theoretical level, the organisation of knowledge in the mind is characterised at a number of levels: semantic networks, schemata, and mental models. All are constructed around the notion of nodes and links, a central difference being that a node can be postulated for unitary concepts to single propositions to whole scenarios.

3.3.4.1 Semantic networks

Underpinning the notion of a semantic network is the assumption that the meaning or comprehension of a concept is embedded in its relationships to other concepts. The origin of semantic networks lies in Aristotle's associationism, the idea that behaviour is controlled totally by associations learned through concepts, and reductionism, the idea that concepts are built

on more elementary concepts. One of the earliest and most influential theories of a semantic network approach to knowledge representation was established by Quillian (1966). Quillian's theory of semantic memory proposed a network storage and access model in which concepts, corresponding to particular senses of words or phrases, were represented as nodes in networks. Properties relating to concepts were represented in networks as the labelled relational, two-way, links from nodes to other nodes. The complete meaning of any concept thus was the entire network emanating from the initial concept node. Quillian's theory formed the basis of later work on knowledge representation in psychology and artificial intelligence, particularly in the development of a range of semantic networks and their notations for representation in computer systems.

One of the most detailed theoretical explications and extension of Quillian was by Collins & Loftus (1975). Their model highlighted the "spreading activation" character of the semantic network. They assert that in information processing, concepts in the structure were activated simultaneously when a person saw, heard, read, or thought about concepts, and were processed through activation of all their associative relations in parallel, with the strength of activation decreasing according to distance from the starting node. According to Collins & Loftus, this activation process permitted verification of knowledge. Semantic network approaches focus almost exclusively on the representation of word meaning. They attempt to represent all knowledge in a single, uniform format with concepts and their relations forming the unit that is the knowledge structure.

3.3.4.2 Schemata

A number of theorists have developed theories of representation based on units larger than semantic networks (Bartlett [1932]; Minsky [1975]; Rumelhart & Norman [1985]; and Schank & Abelson [1977]). The major function of these approaches was to add such structures into holistic units that allowed for the encoding of more complex inter-relationships among the lower level units. Minsky (1975) for instance claimed that most semantic network theories of representation were on the whole too minute, local, and unstructured to account for the effectiveness of common sense thought. He argued that the chunks of knowledge ought to be larger and more structured in order to explain the apparent power and speed of mental activities. He felt

that the nodes and relations of semantic networks did not allow one to sort or structure knowledge into higher-order representational units. These larger data structures for representing the generic concepts stored in memory have been called schema.

A schema is a knowledge structure that represents some domain, such as generalised case of object or event or state. According to Rumelhart & Norman "schemas are like models of the outside world" (Rumelhart & Norman, 1985: 36), functioning both as structures of knowledge organisation in memory and as a device for organising sense data into coherence during the act of perception. Rumelhart (1984) argued they were used in interpreting sensory data, in retrieving information from memory, in organising actions, in the determining of goals and subgoals, in the allocation of resources and generally in guiding the flow of processing. He claimed they determined which information would be encoded or retrieved, and provided the scaffolding for interpreting and organising information that was presented.

Schema theory posits that there are schemas for generalised concepts underlying objects, situations, events, sequences of events, actions, and sequences of actions. Schema theory also supposes that the human memory system contains countless packets of knowledge that vary in complexity and level of application. Each packet specifies a configuration of other packets (sub-schema) which represent the constituents of the schema. An important role of schema is to link new information in some way to existing knowledge. Rumelhart (1984) posited that people find a "best-fit" existing schemata, to account for observable features of situations or entities, and either adapt their view of the observable features to match the schema, or adapt the schema to match the observable features. In this way the features or properties of external information are recognised by matching them to those associated with existing schemata and the new information is internalised by either matching it, changing it to fit, or changing schema to fit.

Minsky's paper (1975) has had great influence on the study of knowledge representation and is probably the most widely referenced contribution to the field. Minsky developed the notion of schemata in terms of frames. The basis of his frame hypothesis was that knowledge is organised in terms of prototype structures of procedures and actions to be used in specific situations. Frames are data structures intended to represent a stereotypical situation; they

contain named slots which can be filled with other expressions, fillers, which may themselves be frames. For example, given a frame representing a concept, an instance of the concept can be generated by filling in its slots. His idea was that the upper levels of the frame are fixed and represent unalterable truths about the object or situation, while lower levels consist of "terminals" or "slots" which are filled with specific instances. According to Minsky, frames incorporated all of the individual's knowledge about the particular situation, with frames for various situations being only loosely connected with another through their common procedures. The entire network of frames was thus a representation of all the individual's knowledge.

Schank & Abelson (1977) developed the notion of schema in terms of scripts. A script can be thought of as a schema for a typical or frequently occurring or expected sequence of events, for example, a visit to a restaurant. Schank & Abelson based scripts on the idea of scripts in a play, where an actor is given an ordered sequence of events to perform. The script provides the structure necessary to understand the temporal order of events, and allows inference of many details. Later Schank (1980) proposed that, instead of scripts, we have many general scenes in memory called MOPS (Memory Organization Packages), structures that resemble scripts.

Frames and scripts are particularly appealing as means of knowledge representation because psychological studies have shown that people tend to rely on knowledge from previous experience, work with this knowledge and adapt it to handle new or slightly different situations. Scripts however only specify knowledge about events that are stereotyped. While frames provide a suitable conceptual framework for representing stereotypical uses and for embedding the specific stereotype in a more general stereotype, there are no operational approaches proposed by or readily apparent from the theory for determining the frames or for describing states of knowledge as frames. It was on this basis that frames and scripts as an approach to knowledge representation in this study were rejected.

3.3.4.3 Mental models

The idea of mental models is attributed to Craik's description (1943) of an initial representation of external reality and possible actions through which organisms use knowledge of past events to test alternative actions for best

outcomes for effective reaction. Oden argued that it has been apparent to researchers for some time "that much of people's knowledge is structured in terms of internal models of the world they experience" (Oden, 1987: 212). Mental models theory provides an explanation of how knowledge structures are used in interaction, forming the basis of dynamic spatial or verbal representations of systems components and their relationships for testing hypotheses about system behaviour, and testing hypotheses about possible responses and outcomes in the interaction. Brewer has provided an explanation of the differences between mental models and schemata. He claimed that schemata were existing "generic knowledge structures while mental models were specific knowledge structures constructed to represent a new situation through the use of generic knowledge" (Brewer, 1987: 189). Norman (1983) defined mental models as internal representations from which people predicted and explained in their interaction with the environment, other individuals or technology. The discourse on mental models is consonant with the cognitive viewpoint.

In summary, while there is widespread acceptance that knowledge is organised as a network of memory components, the theoretical characterisation of knowledge in this study is in terms of schemata. Schemata focuses on the structure of a domain of knowledge, rather than on the meaning of elemental concepts which are the focus of semantic networks. A schemata represents the "big picture", a notion also consistent with the cognitive viewpoint.

3.4 OPERATIONALISING KNOWLEDGE STRUCTURES

While the literature provides a range of theoretical frameworks for representing knowledge, methods for constructing the representations in some meaningful way to enable some kind of analysis to take place are not so abundant. A number of approaches to operationalising a knowledge structure based on a networks approach have been developed across a range of disciplines, and these were considered in establishing the methodology for this study.

Approaches to operationalising knowledge structures differ in terms of the form of the generic data included in the node (concept or proposition), and in terms of their treatment of concepts corresponding to the content words.

Some content words are left intact in some approaches, while others are translated into more "primitive" concepts. Following is a brief review of a number of key approaches to operationalising knowledge structures from a range of disciplines: information science, artificial intelligence, education, language studies and the social sciences, and a consideration of their acceptance or rejection for the purposes of this research.

3.4.1 Approaches in Information Science

Information science has developed many general approaches to representing knowledge, particularly in the form of classification schemes. These schemes are used to describe the exosomatic stores of knowledge primarily collected in libraries and information agencies, rather than describing an individual's structure of knowledge. They tend to present knowledge as isolated descriptors of document aboutness, rather than interrelationships in some explicit propositional form. While relationships are ostensibly displayed in the form of groupings called classes or facets, the relations are not particularised and remain implicit. Some relations are also implicit in cross-referencing mechanisms such as broader, narrower and related terms. These roles function more to restrict the meaning of a concept rather than to provide more explicit relations. The use of auxiliary schedules in Dewey, the colon in Universal Decimal Classification, indicate the realisation of relations other than generic relations. While at a surface level these schemes attempt to link documents together by grouping similar documents in one class, there is no attempt at specific interlinking to create some kind of conceptual network. This indeed was Brookes' goal, and he saw Farradane's contribution of relational indexing as playing a role in this.

Farradane's relational indexing has made an important contribution to knowledge representation. Farradane based his approach on the notion that any analysis of information for storage and effective retrieval must be in terms of the concepts and relations between them. He developed a two dimensional form of representation that attempted to reflect the way in which human knowledge is really constructed and growing from the particular to general (Farradane, 1967; 1952). Farradane saw the need to create a means of expressing relations which would be of general application in any subject and at any level of complexity, claiming that meaning needed to be unimpeded by the subject matter or by linguistic considerations.

According to Farradane, relational indexing "is a mean of expressing relations on the basis of the mechanisms of thought" (Farradane, 1980a: 267). He asserted that complexity, ambiguity and arbitrariness of language were the principal difficulties in appreciating meaning. He saw classification as representing a theory of the structure of knowledge, that is, of the relations between the different parts of knowledge, and he saw relational indexing as an attempt to simulate the structure of knowledge, not just by identifying concepts, but articulating standardised rules relating to concepts to establish relationships. His approach was alinguistic, in that the structure of language was not being directly used. He defined knowledge as "a memorable record of a process in the brain, something available only in the mind ... a structured (interrelated) set of concepts in the brain" and Information as "a physical surrogate of knowledge" (Farradane, 1980b: 77).

Initially Farradane conceptualised knowledge in terms of isolates, uniquely definable items of knowledge; and operators, the relations between them, representing logical relations. He saw these as being inserted in symbol form to give a linear representation of a given complex subject (as a combination of isolates and operators) in a form called an analet. This conceptualisation was later developed as a more complex representational notation based on four categories with sub-categories: (1) entities - physical, chemical, living, artefacts; (2) activities: - physical, living, physical abstract, mental abstract; (3) abstracts: - physical abstract, symbolic, behavioural, space, time; and (4) properties: - physical, behavioural and physiological, abstract. Each category articulated at a range of levels: simple, complex, comparative, interactive (Farradane, 1952: 74).

A taxonomy of explicit relations was also developed. Nine explicit relations (operators) were developed to express all shades of meaning (Farradane, 1980a: 269-272). These relations were: *concurrence* (occurrence or juxtaposition of one thing with another); *self-activity* (describes the intransitive verb situation); *association; equivalence; dimensional* (time, space, state); *appurtenance* (expresses the purely generic relation); *distinctness* (applicable in the expression of the relation of an imitation or a substitute), *action* (action of any thing or process on another thing or process); and *functional dependence* (causation). Associative mechanisms were also represented, for example, /- to indicate action. These were standardised to ensure consistency of meaning. The relations were represented as linear

strings or ring diagrams, depending on the complexity and the need to avoid repetition of words to establish clarity of meaning.

While Farradane's approach permits full representation of any type of complex subject, and enables subtleties of meaning to be exhibited reproducibly, it is not simple to apply, and its application seems to be limited to describing multiconcept subjects, rather than propositions. Overall it is functional, but it is not purposeful or personal. The characterisation is inconsistent and confusing, and the relational notation does not address the bridging inferences that would need to be made in order to construct a larger representation.

3.4.2 Approaches in Artificial Intelligence

A number of notations and mapping schemas have been developed in the area of artificial intelligence. Based on his semantic network theory, Quillian's basic notion (1966) was that knowledge could be represented by a kind of directed, labelled graph structure in which the basic structural element was a set of nodes interrelated by relations. Quillian's whole model consisted of a mass of nodes, interconnected by different kinds of associative links, with each node corresponding to an English word concept and representing the meaning of this word. He establishes two basic types of nodes: type nodes for direct representation of meaning; and token nodes, representing the definition of one word in terms of other word. He also developed a number of different kind of associational relations among sets of nodes.

Most other formalisms and notations of network models are considered as variants and extensions of Quillian's basic format. The basic form of structure in these is an interrelated set of property or feature lists, each defining a concept, and a restricted set of relations. One of the most important applications of the semantic network has been the work of Schank and colleagues expressed as Conceptual Dependency theory (Schank, 1975; 1981). Schank aimed to reduce natural language sentences to the conceptualisations underlying them with the use of primitive actions. He sought a representation that was unambiguous, unique, and language independent, arguing that if two different sentences had the same meaning, they should have the same representation. In order to carry out this process, he proposed that all incoming information, based on concepts and relations

between them, be broken down into primitive elements and stored in terms of this set of conceptual primitives. Conceptual primitives were developed for physical actions, changes of state, instruments for other actions, and mental acts. In addition, six conceptual categories or types of concepts were established, these being physical objects, actions, locations, times, action aiders, and attributes of objects. These conceptual categories combined in certain ways, specified as sixteen conceptual syntax rules. In addition to these primitives, a number of other primitive elements were developed, for example, a set of conceptual roles. Conceptual Dependency also made use of a set of modifications corresponding to tenses in language.

In terms of the present study, a number of problems are evident with this approach. The approach does not provide a direct means of determining a compatible representation of the state of knowledge of the recipient. It seems to require an unrealistic precise definition of concepts and provides no mechanism to analyse pragmatics; these are not described exactly enough to be understood and implemented. The links are not intuitively understandable. A key problem also is that the notation is likely to become clumsy and unwieldy as the network structures become large and complex. The concern that everything must be reducible to a small set of semantic primitives, forcing all concepts into some basic set of meaning postulates makes it hard to explain discovery of new concepts as well as the metaphorical use of concepts.

Sowa (1984), like his counterparts, was also interested in natural language processing. Based on strong psychological and linguistic evidence, Sowa proposed a Conceptual Graph - a finite, connected, biparte graph - to represent a sentence. In essence it was a mini-semantic network. Its biparte structure involved two kinds of nodes, concept nodes and conceptual relation nodes, and a path between them. Concept nodes represented *entities*, *attributes*, *states* and *events* while relation nodes showed how the concepts were connected. Conceptual relations were a set of basic links that were widely used and common to many different domains: these included: *case relations*, such as agent, patient, state, experiencer, recipient, instrument, destination and result; *spatial relations*, such as location; attributes, such as characteristic or part; *intersentential relations* such as before, after, cause, purpose, method; *mathematical relations*, such as measure, greater than, less than, equal; and *metarelations*, such as kind, subtype, and description. Sowa

also specified a type hierarchy, such as *universal type, entity, event, state,* and *role play,* and also developed a basic notation for conceptual graphs.

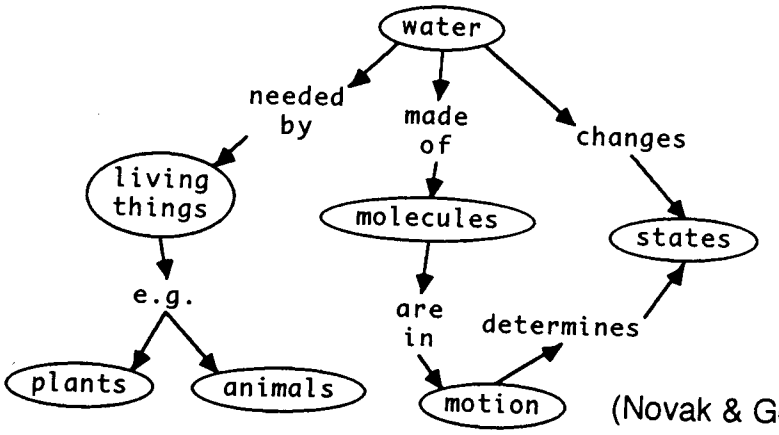
Sowa's approach is potentially useful for this study. It incorporates inferencing ability with syntax and semantics; it uses the power of a semantic network to structure existing knowledge and unifies these techniques in a consistent form. The model is designed to develop a memory structure that is capable of encoding and representing a reasonable range of the information it is likely to encounter, and it has direct and explicit rules for translating external information.

3.4.3 Approaches in Education and Language Studies

The fields of education and language studies have generated some relevant approaches and notations to externalising individual's structures of knowledge. These include concept analysis, discourse analysis, and argument analysis.

The concept analysis approach focuses on representing knowledge structures through determining the global structure of the message, that is, establishing perceptions of the hierarchy of concepts, from superordinate to subordinate; and identifying the texture of the message, that is establishing the various meanings of the relationships. It enables people to articulate central concepts, clarify their meaning, and establish how and why they are linked. Operationalising this concept analysis approach is through concept maps, developed by Novak and Gowin (1984). An example of a concept map is shown in Figure 5:

FIGURE 5
CONCEPT MAP: NOVAK & GOWIN



(Novak & Gowin, 1984: 16)

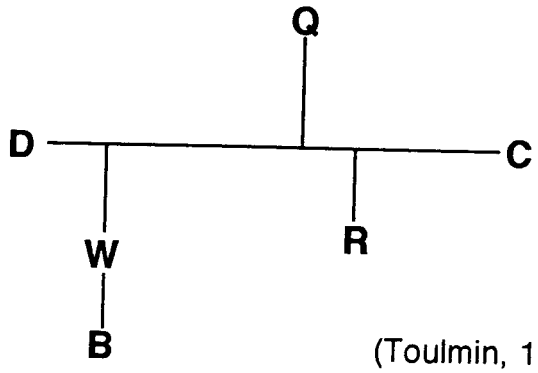
Concept maps are essentially a graphical representation of concepts and their interrelations. They are structured from the surface expressions, where the links are a word or phrase derived from the expressions. Novak (1985) further devised a variety of scoring keys for concept maps based on number of meaningful, valid propositions; valid levels of the hierarchy identified; valid and significant cross-links between one segment of concept hierarchy and another; and specific events or objects that are valid instances of those designated by concept label. Concept mapping has been used extensively in primary and high school education as a learning heuristic, and has a substantial research literature to support its application. While the approach is based on natural expression, the nodes in the structure are based on single concepts linked together, making it unwieldy for representing a large knowledge base. A concept map of one girl's knowledge of the drug heroin would likely consist of thousands of nodes and relations.

Halliday & Hasan (1985) have presented a framework for discourse analysis. They asserted that the written and spoken word contained multiple layers of meaning based on a multiplicity of contexts. They believed that the thread which linked these contexts and which helped to clarify meaning could be identified through an analytical process. Their process sought to identify the subject matter (field), the relationships and values (tenor), and the purpose behind the conversation or text (mode). In the identification of field, one would expect a statement of the subject area and how that subject area related to other subject areas, and a description of what was happening. Tenor was concerned with the major actors and their relationships to each other and to the action or subject area. Mode reflected what the participants expected from the conversation or the text, for example, whether the text was intended to inform or persuade. This approach is particularly advantageous in articulating the context of meaning. However, the narrow scope of field, tenor and node is considered too restrictive as a framework for representing knowledge structures. It limits the elicitation of knowledge to particular and narrowly defined types. It is felt that this approach would not capture the richness, scope and variety of the girls' knowledge to establish the research's credibility.

Argument analysis, as a potential approach, is drawn from the philosophy of science, and is regarded as one of the major themes of the rhetoric of western thought. The focus of the argument analysis approach is measuring how

individuals analyse and solve problems in a particular subject-matter domain. It is based on a jurisprudence model of argument (Toulmin, 1958; Toulmin et al, 1979). Toulmin presented a model of the components of a single argument, consisting of datum, claim, warrant, backup, qualifier and rebuttal, as shown in Figure 6.

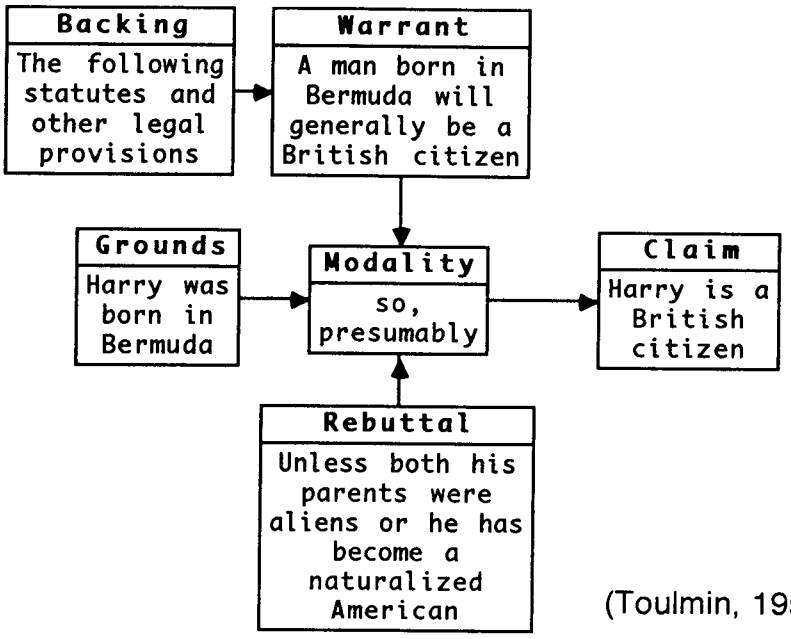
FIGURE 6
ARGUMENT ANALYSIS: TOULMIN



(Toulmin, 1958)

Its framework was expressed accordingly: a person is assumed to take some information, called "datum" D and makes a "claim" C, that is based upon the datum, this constituting a D-C unit. However, there may be certain information, beliefs, or other factors that permit the individual to make the claim, and this is called a "warrant", W. Quite often, an argument is supported by additional "backing information", B and backing is explicitly stated. Two further components of the model are the "qualifier", Q, which indicates one or more particular constraining conditions or grounds under which a claim can be made, and the "rebuttal", R, a statement which is essentially counter to the claim. This basic model can easily be adapted to represent a series of arguments. An example of working with this approach is provided at the web site: *http://www.ksi.cpsc.ucalgary.ca/articles.* This is shown in Figure 7.

FIGURE 7
EXAMPLE OF ARGUMENT ANALYSIS: TOULMIN



(Toulmin, 1958)

This approach to representing knowledge structures was rejected because it captures a specific type of knowledge, and was seen to be more applicable to representing global rather than specific arguments. This could mean that elements of the declarative knowledge of a girl could be left out. The process of its representation is also very time consuming, and required considerable subjective judgement as to what would be included in the argument structure, where that would be placed, and what would be rejected.

3.4.4 Summary

Any representational approach imposes some organisation on the knowledge that is extracted. All approaches documented here attempt to represent theoretical knowledge structures which to some extent approximate the true knowledge structures an individual possesses. They capture many different kinds of knowledge structures: general structures, specific structures, structures of meaning, argument structures, discourse structures, and structures for different kinds of knowledge, such as procedural and declarative knowledge. The approaches vary in terms of their theoretical frameworks, levels of complexity, and in the nature and characterisation of the

basic knowledge unit. In selecting an appropriate approach to operationalisation, the following aspects were carefully considered: the nature and purposes of these representations against the purposes and limitations of this study; the nature of actual data collection; the nature of the information exposure; the potential duration of the process; the physical and intellectual capabilities of the respondents; and environmental limitations, such as availability of respondents in terms of the block of time required to complete the process.

3.5 THE STUDY'S APPROACH TO OPERATIONALISING OF KNOWLEDGE STRUCTURES: CONCEPTUAL GRAPH STRUCTURES

For this research, the approach selected for representing a person's structure of knowledge is based on empirical research of Graesser (1981) and Graesser & Clark (1985), and derived from Sowa (1984). The broad focus of Graesser & Clark's work is how knowledge is conceptually represented and organised in the cognitive system. In their research the structure of a person's knowledge is operationalised as a Conceptual Graph Structure, a graphical representation consisting of self-contained units called statement nodes, which are interrelated by a network of relational arcs, thereby enabling both the basic ideas units within a knowledge structure to be isolated, and interrelated, and thereby generating an interrelated set of nodes and relations to form a conceptual graph structure.

A number of reasons underpin the selection of Graesser & Clark's approach.

1. *their research demonstrates the workability of the approach.* While focusing on understanding the inferencing process in the comprehension of text, the research is based on mapping of knowledge derived from print-based material. While the passages of text used are considerably shorter than those used in this study, they clearly demonstrate the workability and manageability of the overall approach.

2. *their approach focuses on the mapping of declarative knowledge, and retains the natural expressions of the respondent, rather than breaking the expressions down into more primitive, generic expressions.* The graphs, based on the natural expressions of the individual thus have a

sense of immediate and truthful correspondence with the knowledge the individual has articulated. This correspondence is consistent with the qualitative approaches underpinning this study.

3. *the approach is functionally adequate for the task.* The focus of this research is on the structure of knowledge, not specifically on the content of the knowledge. Representing the structure in terms of content expressed alinguistically seems to serve no functional purpose for the research. While this created some instances of ambiguity, modifications to the natural expressions do not destroy the integrity of the expression. These are discussed later.

4. *the approach facilitates the easy comparison of ideas generated by each girl with the ideas presented in the text.* This acknowledges an important assumption established earlier, that of frames of reference, and that the ideas presented may be derived from a number of information sources. The first source is the explicit linguistic material, that is, the text; the second source is other knowledge structures that are stored in long-term memory; the third source consists of the goals of the girls who read the text. There is evidence to suggest that structures may vary when individuals use texts for different purposes (Black, 1981; Masson, 1982; Streitz, 1982).

5. *the process of generating the knowledge structures from the responses of the girls is easy to do.* Researchers tend to report high interjudge reliability scores in segmenting the written and verbal responses into statement nodes (Graesser & Clark, 1985).

6. *the process enables changes in knowledge structures to be readily identified.* This is a central requirement of this study.

An important consideration related to the type of knowledge that would be elicited from the girls. The debate on types of knowledge is dependent on epistemological viewpoints and contexts. Grover & Glazier (1986) have presented a hierarchical, scientific taxonomy of knowledge based on real world phenomena, and includes symbols, definitions, concepts, propositions, hypotheses, substantive theory, formal theory, grand theory, paradigm, world view. Machlup (1980) developed a classification based on five types of

knowledge: practical, intellectual, small-talk and past time, spiritual, and unwanted. A number of writers have developed specific functional taxonomies, distinguishing between forms of knowledge, types of knowledge use, bases for validating knowledge, and sources of knowledge. Some taxonomies of knowledge are in reality taxonomies of knowledge sources, and focus on dimensions such as locus (sources that are proximate or distant in relation to the user); format (eg. formal, personal) and derivation (craft versus scientific). As already established, the study of information utilisation has tended to give some emphasis to the procedural versus declarative knowledge debate, and on this basis, it was decided to acquire declarative knowledge from the girls.

An important decision at the outset of constructing the conceptual graph structures was the nature of the unit of knowledge: the form of the content of the node. This was a decision about the extent of breaking down the ideas derived from the acquisition approaches into generic units, so that the structure could be constructed. What would be the data of a node?

Lindsay & Norman posits 3 forms of units:

(a) *propositionally based approach* in which knowledge is assumed to be represented as a set of discrete symbols or propositions;

(b) *analogical representation* in which the correspondence between the represented world and the representation is as direct as possible, traditionally using images and other analogical representations.

(c) *procedural representation* in which knowledge is assumed to be represented in terms of active processes or procedures, directly interpretable by action systems. (Lindsay & Norman, 1977)

For the purposes of this research, the basic unit of a node is a description that is similar to a proposition, in a coherent form, and generally expressed as a sentence. While the whole field is far from settled on a general theory of representation, propositional representations as the basic unit of a knowledge structure are prominent in the literature, and many of the comprehensive theories of knowledge representation use propositions to

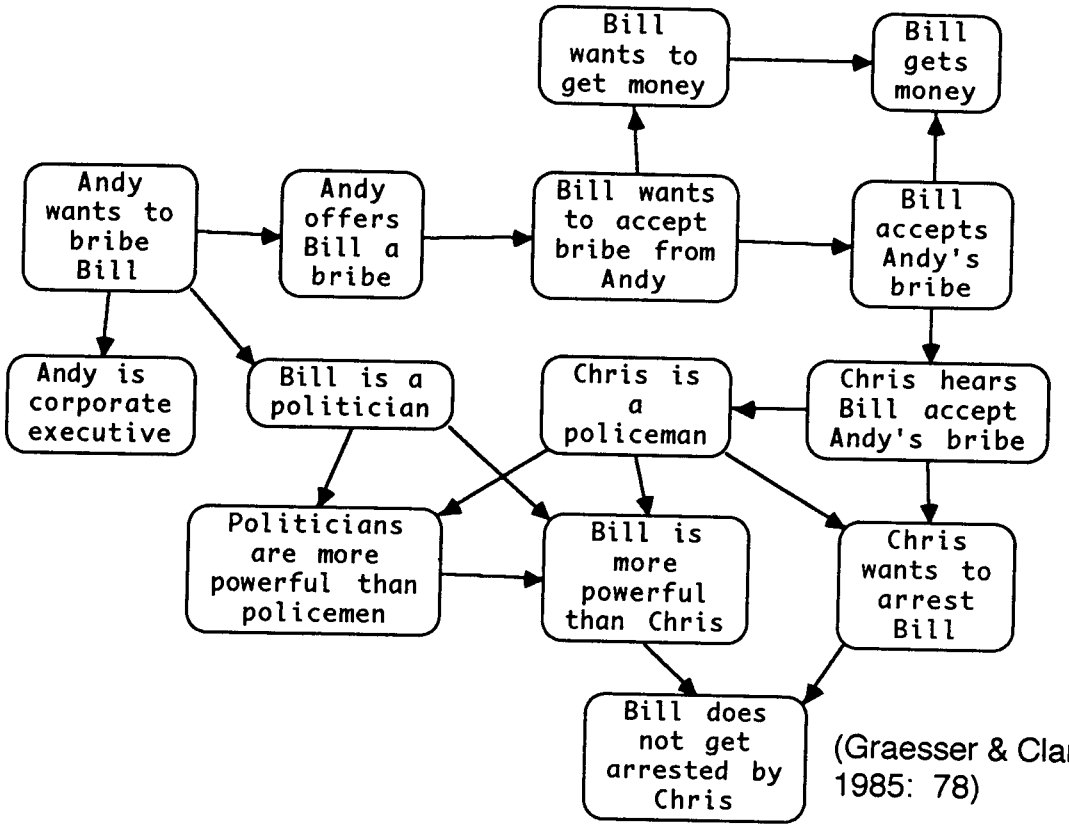
represent knowledge. (Rumelhart, Lindsay & Norman, 1972; Kintsch & Van Dijk, 1978; Schank, 1975; Schank & Abelson, 1977; Sowa, 1984).

This also raises the question of the use of an abstract proposition or the surface proposition as naturally expressed by the respondent. There is acceptance of the notion that a proposition may not necessarily be a sentence nor a string of words. It can be viewed as an ideational unit, an abstract unit of knowledge in a most reduced and coherent form. While propositions can be expressed as sentences, they are assumed to have a non-linguistic form in the mind. The same proposition can be expressed in many different ways in a given language. In some approaches to representation, propositions are expressed in a notational form, containing symbols representing one or more concepts. The symbols may be words or not. Some propositions also contain logical operators that relate the concepts in various ways (Anderson, 1976).

Studies show that people retain the abstract "essence" of what they hear. Propositions can recapture the essence of a statement. For example, Kintsch (1974) found that the meaning of a text can be effectively captured by lists of propositions and that their recall can be scored for its match with propositional units.

This study thus assumes that the surface structure of knowledge representation is a set of propositions (representing node in the structure) that are ordered and related by various relations. It assumes that knowledge structures are not merely unrelated lists of propositions, but rather, integrated as a coherent and meaningful whole. Mapping declarative knowledge as a conceptual graph structure, and including surface propositions as the unit of knowledge, results in knowledge structures that resemble the example of Figure 8:

FIGURE 8
EXAMPLE OF A CONCEPTUAL GRAPH STRUCTURE:
GRAESSER & CLARK



(Graesser & Clark, 1985: 78)

PART 2 OPERATIONALISATION

3.6 PROCEDURES

This part of the chapter presents a chronology of procedures undertaken to collect the data, derived from the theoretical considerations presented above. These include procedures related to the limitations of the study, selecting the girls, setting up the experimental conditions, creating the focus problem, establishing a general procedures plan, determining operationalisations of exposures to information and knowledge structures, and detailing all the procedures in the data collection process.

3.6.1 Limitations of the study

The focus of this study is on the cognitive effects of exposures to information and how these effects are manifested in changes to a person's knowledge structure. It makes a clear distinction between the structure of knowledge and the content of the knowledge. While changes in structures will reflect changes in content, the study does not explore substantially any aspects related to the actual content of knowledge, such as for instance, the rightness or wrongness of the content presented by each girl, and the extent of reproduction or nature of the modification of the content from how it is presented in the original material to how it is presented by the girls. It does not extensively focus on the selectivity and relevance of the information, that is, what content was selected and what was rejected, nor examine fully the reasons for this. While it is acknowledged that content is fundamental to the carrying out of the study, and that the girls make choices about what content is important based on their frames of reference, the focus of the research is looking at how the structure of the content changes, and effects in terms of information utilisation.

In this study, all nodes and links that are presented by the girls are considered. All nodes and links are considered equally important, with no consideration given to the typicality, distinctiveness, conceptual distance or necessity of the set of nodes and relations in the structure.

The research context is a school environment, and some general comments are made about this learning environment. However, this study is not a study about the nature of learning. While its findings may contribute to further understanding this theoretical area, and the potential applications of the findings may contribute to teaching and learning practices, larger considerations of the relationship of this study to learning are not addressed. It is acknowledged that this study may open up potential areas of research inquiry in relation to learning.

3.6.2 Selection of the girls

The data for this research was obtained from four girls in Year 12 at Marist Sisters' College, Woolwich (Sydney Australia). Year 12 is the final year of high school in New South Wales, and at the end of this year, students take

public examinations for their Higher School Certificate (HSC). At a broad level, this sample is distinguished from the population of Year 12 students (and by implication, age of 17 years approximately) in that all participants are female, and nominally Catholic.

The girls were not randomly selected. The group consisted of girls thought most likely to confirm or disconfirm the question of how a person's knowledge structure changes with each successive exposure to information. The key question in selecting the girls was: given the measuring instrument, who would be the best girls to select? It is recognised that testing speculations about changes in private knowledge structures in an empirical way is difficult because it involves direct investigation of subjective knowledge structures. Understanding changes in knowledge structures and the effects of these changes must depend on systematic comparison of knowledge structures. At a practical level, and established in the theoretical discussion above, representing knowledge structures is dependent on language. A fundamental issue related to language is: does it expose all of the knowledge that an individual has in a knowledge structure? Many forms of knowledge may not be readily uncovered by a language-based methodology. It may not explore knowledge that is difficult to express in language, and thus there may be a bias towards knowledge that can be expressed in language.

A key criterion in the selection of the girls was thus their fluency in written and spoken English. Consequently, they were selected on the basis of having a high level of English fluency in both written and oral communication. This was done in consultation with classroom teacher, by choosing the four girls from the 2 Unit English strand who demonstrated the highest levels of oral and written communication skills. This strand is the highest level of English to be studied at HSC in the school, other levels being 2 Unit General English and 2 Unit Contemporary English.

The four girls were in their final year of high school, and had ages ranging from 17 years 1 month to 17 years 10 months. On the basis of official school records, they all had an above-average academic record, performing in the top 20-30 percentile ranking in the state of New South Wales, and having a high level of English language competency. As part of the collection of demographic data, the girls were asked to describe themselves as students, and all girls indicated that they had high levels of motivation for learning. For

example, Girl #1 commented: "I achieve when I am motivated, and I especially enjoy learning artistic subjects such as music and drama. I'm confident in public performance". Girl #3 described herself as "committed to being successful in school studies, although I'm easily distracted. I enjoy the academic competition of my school subjects". In terms of employment background of parents, two girls had parents employed professionally, and two girls had parents involved in technical trades. The girls came from diverse cultural backgrounds: Italian, Filipino, Anglo-Celtic, and Arabic.

3.6.3 Context of the study

The research investigation was placed within the context of the established school curriculum in NSW to ensure that there was not an oversimplification of the information environment confronting the girls. Accordingly, the research procedure was framed within a typical curriculum-centred task that would normally require exposure to and selection of information. The specific topic of the research was information related to the drug heroin. There is research evidence to suggest that the topic of "drugs" is an important life concern of adolescents (Edwards and Poston-Anderson, 1993). Data provided by the New South Wales Health Department: Drug and Alcohol Directorate shows that one in every five deaths in New South Wales is caused by drugs, with tobacco accounting for 71% of drug caused deaths. Opiate caused deaths rate highest amongst the 15 - 34 age group, and account for 33% of the total drug caused deaths in this group (New South Wales Health Department, 1993).

It can be argued that the procedure which underpins the research (ongoing exposure to information, questioning based on that information, and recording what is known), is a common place process that happens in classrooms in one teaching period, and is repeated many times during each school day. Thus the research process attempted to reflect a typical informing process which school students encounter during their learning at school. This is affirmed by learning theorist Ausubel who claimed that meaningful learning takes place when new information is linked to "relevant, pre-existing concepts or propositions in the learner's own cognitive structure" (Ausubel, Novak & Hanesian, 1987: 159). Brookes also claimed that the "simple sequence of additive operations embodies, I believe, the generally accepted view of the process of learning". He further states: "there is no way of

inspecting the private knowledge structures of an individual without eliciting his response to questions as, for example, by written examination" (Brookes, 1974: 148).

While this may be regarded as quite an unsophisticated approach to establishing a person's knowledge structure, it is the traditional way educational systems continue to measure the acquisition and understanding of information, as typified by the formal examination structure of the Higher School Certificate that the four girls would undertake later in the year.

To further reflect a school environment, a time limit was imposed on each sequence of exposure. The successive exposures to information, three in number, were each expected to take 50 minutes, a time frame representing the length of a school timetabled subject period. The girls were accustomed to working in this time frame where they are provided with new information, have opportunity to reflect and talk about this information, and record their knowledge.

3.6.4 Focus problem

A hypothetical task was developed to provide a context for the research. It served to focus the content and to set realistic boundaries on this content. The hypothetical task also provided a limited set of prompts, that is, cues for the girls in recalling ideas, as well as cues for organising their ideas. It was constructed as a typical research activity in which the students would normally actively seek out information to develop their responses to the task. It was drawn from the NSW Higher School Certificate subject "Personal development, health and physical education" course. The purpose of this subject is to provide opportunities for students to develop the knowledge, skills and attitudes needed to understand, accept and lead a healthy lifestyle, and in so doing, develop significantly their capacity for understanding how communities can establish healthier conditions of living. Specifically the subject aims to develop in each student: self-esteem and social well-being, and an ability and commitment to make and act on informed health decisions at a personal and community level.

The topic of the focus problem was drawn from one of the option modules in the course "Two social health issues: Drug use and HIV/AIDS", with specific

focus on drug use, specifically heroin. This module aims to develop in students

1. an awareness of the nature and incidence of drug use and HIV/AIDS infection;

2. an understanding of the critical impact of these two social issues on individual and community health; and

3. the ability to apply these understandings to their personal behaviour.

The module content focuses on nature and incidence of the drug, implications for the individual particularly in relation to its effects, and implications for the community. Specific areas of study in the module include patterns of drug use in Australia, sociology of drug use, factors associated with harm from drug use, consequences of harmful drug use, alternatives to drug use, impact of drug use problems on the community, health promotion versus drug promotion, and the nature of support structures. The outcome of this process was the following hypothetical task, a copy of which was provided to each girl at the commencement of the research procedure:

> *Your local council is concerned about the increase in drug usage in the area, and has approached high schools to participate in a public forum. The public forum will focus on factors associated with harm from drug use, and consequences of harmful drug use on the individual, and making health-related decisions. You have been selected by your school to present a talk, accompanied by a written guide, at the forum that specifically deals with heroin. Your topic will focus on nature and incidence of the drug, implications for the individual, and implications for the community.*

3.6.5 Ethical issues and related procedures

Exploring people's knowledge of drugs is a sensitive issue. A number of procedures were set in place to ensure that there was no breach of ethics in this process. The information to be provided to the girls in the information exposures was taken from reputable sources and commonly available in

school libraries, and the girls were informed of this. The nature of the knowledge acquisition procedures ensured that the girls would be in control both how much information and the specific information content that they provided. Consequently, the collection of data was not seen to unreasonably intrude on their personal affairs. The girls were provided with an official University letter stating guarantee of confidentiality. A record of their names was not necessary at any stage of the research, and was not recorded. In the briefing process, the girls were informed that they could withdraw from the research at any stage without giving a reason. In addition, in this session they were given opportunity to ask questions about the research procedures, and to discuss any concerns that they might have. The girls were also informed that no original material (written discourse and verbal protocols) would be published in a way that would enable them to be identified in the published data. The research was approved by the Human Research Ethics Committee of the University of Technology, Sydney in July 1995. Documentation regarding ethical issues and participant consent are in Appendix 1. This documentation consists of:

1. Two letters from UTS Human Research Ethics Committee documenting approval to undertake the research;
2. Approval of Acting Principal, Marist Sisters' College, Woolwich, to undertake the research;
3. Consent form for participants;
4. Information sheet for parents.

3.6.6 General procedures plan

The general procedures plan is based on Brookes' acknowledgment that his equation is part of a sequence. Brookes indicates that successive information input I_1, I_2 ... I_n in sequence changes the person's knowledge structure from $(S)_0$ to $(S)_1$, from $(S)_1$ to $(S)_2$ and so on, corresponding to the successive inputs:

$I_1 + (S)_0 \rightarrow (S)_1$

$I_2 + (S)_1 \rightarrow (S)_2$

$I_n + (S)_{n-1} \rightarrow (S)_n$

The overall sum of these sequences is:

$\Sigma I + (S)_0 \rightarrow (S)_n$ (Brookes, 1974: 148)

This equation and its sequence resulted in the following procedures plan:

(a) acquire and map base line knowledge structure $(S)_0$ of respondents
(b) exposure to Information I_1
(c) acquire and map base knowledge structure $(S)_1$
(d) exposure to Information I_2
(e) acquire and map base knowledge structure $(S)_2$
(f) exposure to information I_3
(g) acquire and map base knowledge structure $(S)_3$
(h) debriefing and discussion

3.6.7 Operationalisation of exposure to information

In Brookes' equation, ΔI refers to an increment of information, or information input that has been subjectively selected from the totality of physical information (Brookes, 1978), and then is transduced into private thoughts. For this research, exposure to information is defined as the act of disseminating messages; it is giving information in the hope that it will be read and thoughtfully considered. Exposure to information was manipulated in terms of pre-determined amounts of different, publicly available information presented to the girls as printed text at predetermined stages during the research process. They were requested to read and reflect on this information. These print-based documents about the drug heroin were considered to be the starting point for them in making their selections of information ΔI.

The initial selection of possible information sources was made by the researcher, and was obtained from several sources. These were the Centre for Education and Information on Drugs and Alcohol (CEIDA) at Rozelle Hospital, Sydney, and also sources already available in the school library to support the "Personal development, health and physical education" course. The information to be included in the exposures was selected on criteria valued by the Research and Evaluation Section, Drug and Alcohol Directorate, NSW Health Department, these being authoritative and accurate information. This was done in consultation with subject experts teaching the NSW Higher School Certificate subject "Personal development, health and physical education" 2 unit course, and the teacher-librarian in the school with

expertise in the selection of curriculum resources. These teachers had opportunity to assess the potential information, and made recommendations on the suitability or otherwise of this information. The final choice was made by the researcher after this consultation process.

The decision was made to provide different content for each exposure. Providing the same content for the different exposures, that is, holding the information constant, makes the assumption that what to control for is known. This is an inappropriate assumption, given that the research is not based on any a priori hypotheses. Providing different content of information reflects the teaching - learning process in schools which is predicated on the ongoing exposure of new, different information. In addition, it is recognised that the information content of teaching is not randomly selected, but selected to make coherent, logical sense within a specific learning context and specific domain of knowledge, and building on what is known.

The information made available to the girls was derived from three sources:

1. Liz Byrski. Pills, potions, people: understanding the drug problem. Blackburn, Victoria: Dove Communications, 1986

2. Heroin: depressant. Sydney: CEIDA, 1989

3. Drugs and the law. Sydney: CEIDA, 1990

The sequence of exposures was determined to be:

1. *nature of drug heroin*: what it is, how derived, and how used throughout history;

2. *implications for the individual*: effects of taking heroin; and

3. *implications for the community*: emphasis on community control, approaches to treatment, and recovery.

Examples of information for each exposure are in Appendix 2. A number of restructuring and repackaging changes were made to the information to make it more appropriate to the research (Saracevic & Wood, 1981). This process

of information consolidation involved some editing to ensure consistency of expression and terminology; some synthesis of information from the different sources, and retyping for consistency of appearance. While the information was different for each exposure, the physical presentation of this information was held constant by these changes. All information was presented on A4 sheets, with consistent margin settings and type font. Based on considerations of the relevance of information, to have the information exposures of equal length was not considered essential; there was the recognition that length varies with the importance of the topic. The final exposure to information was shorter, and it was considered that this would work to a positive effect, given the time commitment required.

3.6.8 Pilot study

Four Year 12 girls participated in the pilot study. Like the girls in the study, these girls were chosen by the researcher on the basis of their fluency in written and spoken English. They had similar characteristics to the girls in the actual study, in that they were academically motivated students, within the same age range, and had high levels of written and spoken English language fluency. The pilot study followed the general sequence plan as established by Brookes, employing the elicitation procedures of written discourse and oral questioning. The pilot study sought to:

1. establish the appropriateness of information exposures in terms of quantity, sequencing, and presentation of information;

2. establish the appropriateness of the hypothetical task;

3. test overall workability of the acquisition procedures,

4. elicit comments about the realism of the experiment, and to identify and address problems related to implementing the methodology;

5. provide some realistic time estimates for each information exposure, written discourse, and question answering stages; and

6. test the workability of the data analysis procedures. While this was undertaken by the researcher, it was considered important to work with

some real data to test the viability of the knowledge representation procedures and the approaches to data analysis.

The pilot study confirmed a number of important aspects:

1. the information for each exposure was different in content;

2. there was a large amount of new information, that is, information not known before to the girls;

3. the sequence of exposures was logical, and built up to a coherent whole within the parameters of the syllabus and hypothetical task;

4. the information was readable and reflected an appropriate level of technicality and complexity for the educational level of the girls; and

5. the hypothetical task was clear, and a suitable framework for organising ideas.

As a result of the pilot study, a number of changes were made before the commencement of the study proper.

1. The information from the different sources was integrated more carefully to ensure consistency of expression, terminology and appearance. This meant that while the information was different for each exposure, the physical presentation of this information was held constant by these changes.

2. The number of exposures were reduced. In the pilot study, the girls worked through four exposures. A major problem was identified in relation to the quantity of information provided. While the quantity in each exposure was adequate for the girls to deal with in the time frame, and without information overload implications, the time taken to complete all aspects of the research with four exposures was found to too long and too exhausting, with potential effects of tiredness and rushing to get the tasks finished, both of which impact on the quality of the data. This raised issues of the dependability of the data over time. Because of these concerns, the decision was made to reduce the

number of exposures to three. The girls in the pilot study considered this to be appropriate.

3. "Think" time was incorporated into the process. The girls in the pilot study felt that ten to fifteen minutes should be provided for thinking through the ideas prior to being asked to write them down. They regarded this reflection time as important for them to clarify their own ideas in relation to the new information and the hypothetical information task, and to help them organise their ideas more logically so that the relations between ideas made sense. Consequently, this reflection time was built into the data gathering procedures. Given that the approach to knowledge representation requires articulation of relations between nodes, it was felt that this think time would contribute to the clarity of these relations.

3.6.9 Steps in the data collection procedure

Data for this study were collected in July 1995 at Marist Sisters' College, over four days. Data collection took approximately five hours for each girl. Data were collected individually, one girl per day. There was no random allocation of girls to the days; the time was negotiated with the girls to suit their various extracurricular activities at the school at the time and their part-time work and family commitments. While school time was made available to the girls, they agreed to this time in order not to miss their allocated classes, given that their mid-year examinations were to be held within a few weeks.

The procedure and approximate timing for each girl was as follows. Timing was based on pilot study estimations, although this varied slightly for each girl and for each exposure. A general time plan is provided in Appendix 3.

1. *Preliminaries* (5 minutes): Each girl was given general background on the overall research, including the topic focus of heroin; reminded of confidentiality guarantee, already provided in writing; reassured that the process was not a test, but a process of recording what is known, and that the process would be mapped, not marked. She was informed that she had full access at all times to her written responses and was free to refer to them at all times. This was to facilitate consistency of expression from one exposure to another, with the proviso that she was not to alter

previous documentation; rather to record changes of ideas in the responses being currently actioned. Each girl was also asked not to discuss the project with other girls involved in the study.

2. *Steps of procedure* (5 minutes): Steps of the procedure were outlined, including refreshment and meal breaks. An overview of all the stages was given, and any procedural concerns and apprehensions were dealt with.

3. *Demographics* (5 minutes): Some basic demographics were collected. These were recorded on a data collection form, provided in Appendix 4.

4.. *Hypothetical task* (5 minutes): Each girl was given a copy of the hypothetical task. After reading through this task, she was given opportunity to clarify any aspect of the task.

5. *Knowledge elicitation* - establishing existing knowledge as the base measure: This was done in several stages:

(a) Each girl was asked to take the time to think about what she knew about the drug "heroin", using the hypothetical task as a prompt. (10 minutes)

(b) Free generation phase: This was the first step in uncovering and exploring the content of the respondent's knowledge base. Following the reflection time, each girl was asked to write down what ever she knew about the drug heroin, in the context of the hypothetical task provided. As established in Section 3.3, minimum instructions or rules for writing were given. (30 minutes)

The free generation phase was based on these instructions: "Carefully consider the hypothetical task, and take some time to think about what you know in relation to the scenario. Then write down all that you know. Write your ideas in some connected way rather than as single words or phrases. What you write could be in the form of facts, opinions, ideas, attitudes, reactions, and emotions; it could also repeat what you have stated earlier, or could be changes to what you knew previously." No further guidelines to structuring the written discourse were provided.

Each girl wrote down on paper provided for the purpose what she knew about the drug heroin in as much detail as possible, using connected prose. The outcome of this was the writing down of two to three A4 sized pages.

(c) Researcher analysis (15 minutes): At the completion of the written response, the researcher examined the written transcripts to identify areas for probing in the interviews. This process was undertaken to provide a fuller and richer base for generating the knowledge structures. During this time, each girl took a refreshment break.

(d) Question answering phase (15 minutes): In this stage of the knowledge acquisition process, the girls answered a set of questions based on the individual written responses in the free generation stage. From the point of view of the researcher, the questioning protocols were seen to serve several important purposes. Firstly, they were used to enable implicit knowledge to be made explicit, providing a greater richness to the data. Secondly, they were used to validate the ideas expressed in the written discourse, and to verify that what was written was an appropriate representation of knowing, enabling each girl to make surface corrections if necessary. It also provided a degree of precision, credibility and rigour to the methodology. Thirdly, they were used to establish how ideas were linked and ordered, of critical importance at the stage of generating the knowledge structures.

The question answering phase was undertaken in a semi-structured interview, and was audio recorded for later transcribing. Prior to the interview, a general framework of questions was set up, giving the semi-structured approach. This was done in order to provide consistency of approach across the girls, yet to ensure flexibility to tailor questions based on individual requirements. Not all question were asked at all times, rather, they were asked as required.

The questions followed these generic patterns:

Why did X occur? For example: Why do drug dealers mix talcum powder with heroin? Why was heroin smuggled into Australia?

How did X occur? For example: How does a person become addicted? How does a person take heroin?

When did X occur? For example: When was heroin discovered? When is detox necessary?

Where did X occur? For example: Where does detox take place?

What enabled X to occur? For example: What are the factors that contributed to the increase in drug use in Australia in the 1960s?

What is X? For example: What is morphine? What do you mean by Nirvana? What are some of the changes to personality?

What are the consequences of X occurring? For example: What are the consequences of addiction to heroin?

What is the significance of X occurring? Why was the Vietnam War significant to the drug trade in Australia?

How and why questions were primarily asked. A whole range of questions could have been asked, but how and why questions are comparatively cost effective in the sense that they dredge out wealth of information that is functionally important in the cognitive system. There is also the notion that the elicitation methodology could go on and on, bring about an exponential explosion of the knowledge base related to heroin. The aim of the verbal protocols was to enrich rather than to exhaust, consequently pragmatic decisions were made as to when questioning would be terminated. Another limitation was imposed by the girls; in many cases, they simply ran out of things to say.

To guide the process of questioning in order to establish the links, a guiding framework of links identified by Graesser & Clark (1985) was used. Their empirical research developed the following taxonomy of relations:

1. *consequence:* where some event somehow causally leads to another; enables an event to occur; some event results in another event.

2. *implies:* source idea and end idea exist at the same time

3. *reason:* where goal statements are interrelated in a goal hierarchy; source goal is subordinate to end goal statement; end goal is reason for source goal statement.

4. *outcome:* these are specified whether or not the goal is achieved

5. *initiate:* when an event triggers the occurrence of a goal

6. *manner:* when style of some event, place or process is being specified - prevalent when a set of ideas denote how an event / action occurs

7. *property:* describe objects and spatial characteristics

8. *set membership:* capture relationships involving class inclusion

(Graesser & Clark, 1985: 58-75)

Some links occurred naturally as part of the elicitation process, and were explicitly presented in the surface structure of the written and verbal responses. These included links such as "this is because", "this leads to", "as a result", "in order to", "such as", "is a", "but", "because", "although", and "yet". However, some links were implied, and while some of these could be derived unambiguously by the researcher, some needed to be made explicit in order to make sure that the structures constructed from these were an accurate representation of how ideas were linked together by the girl. According to Kintsch & Van Dijk (1978) people do not generally assert what they assume the listener or reader knows.

The outcome of these approaches was a set of expressions, at this point in the procedure in both written and oral form, assumed to be externalisations of the girl's knowledge about the subject under

consideration, and some specification of how these expressions were conceptually connected.

6. *Exposures to information*: Following the elicitation of existing knowledge, each girl was provided with the first exposure to information. Each exposure to information conformed to the following pattern:

(a) each girl was provided with identical copies of the information, and asked to carefully read and think about the information that had been provided.

(b) each girl could make notes, jottings, as she worked through the information

(c) reading / reflection time lasted about 15 minutes

(d) each girl was then instructed to record, in connected written discourse, what she now knows. Each girl had up to 30 minutes to undertake this.

This procedure, and the procedure related to the written discourse, researcher analysis, and verbal protocols, were followed for each of the three exposures to information.

7. *Debriefing*: the debriefing stage was an important stage of the process. This sought to elicit responses in relation to the impact of the information exposures in relation to information utilisation. The discussion centred on the question: "how do you think what you know has changed? The debriefing stage provided opportunities for the girls to reflect on the process, to discuss their own perceptions of changes that have taken place, and express emotions and attitudes.

The outcome of these procedures was a set of written and oral responses that collectively formed the knowledge of each girl prior to the information exposure, and after each exposure to information, as well as a set of statements related to the effects of the exposures. These responses formed the basis for the researcher to operationalise knowledge structures, and then to undertake the data analysis to address the specific research aims.

3.6.10 Generating the knowledge structures

This section documents decisions and procedures relating to generating the conceptual graph structures. As already established, the question of operationalising knowledge structures is a complex and vexed one. Decisions were made on the basis of a considered analysis of the theoretical frameworks for the acquisition and representation of knowledge as documented in Part 1 of this chapter. The girls' knowledge was acquired using written discourse and verbal protocols, and later represented as a conceptual graph structure. The unit of knowledge in a conceptual graph structure was a proposition.

For the purposes of the study, a proposition is a description of a state (something that remains unchanged throughout some time frame), or an event (involving a state change within a time frame), or a goal (some state or event that an animate agent desires) or a style (the modification of an event by specifying the manner in which an event occurs), and expresses a complete thought. It is operationalised as a sentence or string of words that contain at least two concepts linked together to form a meaningful unit expressed in the natural language of the girl.

At a technical level the proposition contains one predicate and one or more argument. An argument is a person, object, region, location, concept which has a specific thematic role such as agent, object, recipient, location and or time. A predicate ascribes properties to arguments and / or specifies how arguments are functionally related. Predicates are usually captured by verbs, adjectives, or some verb and proposition combination. Predicates are not construed as linguistic entities per se, rather as functions of conceptual modules which operate on arguments. For example, "addicts commit crimes" is a natural description of an event by one girl. It contains two concepts "addicts" and "crimes" linked together. The proposition has two arguments "addicts" and "crimes", and one predicate "commit". Some statements have predicates that require only one argument, for example "addicts overdose", while others may require more than one. Some propositions may consist of arguments and predicates that may be broken down further into atomic propositions. For example, "heroin causes weight loss and drowsiness" may be broken down into two propositions "heroin causes weight loss" and "heroin causes drowsiness".

The decision was made to retain the propositions as expressed in the natural language of each girl. Most representational systems that have been developed recognise that the inconsistencies of language present formidable barriers to understanding meaning. Language is not a medium of expression developed specifically for exact and consistent transmission of meaning, and the development of special languages reflect this, for example, the mathematical language for measurement and calculation. For exact expression of knowledge and meaning, the development of semantic equivalents has taken place. In this study, the "meaning" is not the focus, and it was felt that it was not necessary to translate natural expressions into an alinguistic form of propositional logic.

A big stumbling block in the strategy of using notational representations of propositions is the difficulty of translating natural language utterances into forms comparable to those required by propositional logic. Often precise and objective rules are specified by the formal logical systems for creating propositions which then cannot be used, because they exclude those ideas of people that do not fit precisely into the system's logical structure. Generally rules for doing this are intuitive and informal.

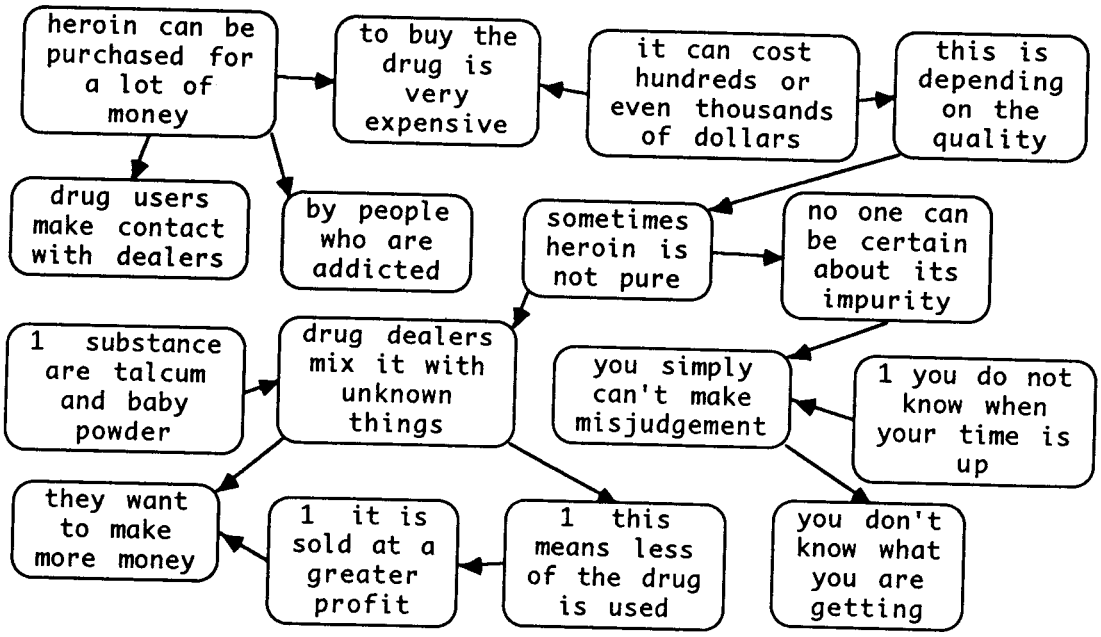
At times, the process of generating the conceptual graph structures did not always involve a simple one-to-one mapping of the information units from the knowledge acquisition stage to the structuring stage, and some modifications were made. This related to expressions in the written and verbal responses that contained more than one atomic proposition. Generally these were retained as expressed by the girl, unless one of the atomic expressions had been further extended. For example, one girl stated "heroin causes weight loss and drowsiness" followed by the statement that "drowsiness can affect driving". This was specified in the conceptual graph structure as three propositions (1) "heroin causes weight loss", (2) "heroin causes drowsiness" and (3) "drowsiness can affect driving", so that accurate linkages could be made to retain the integrity of the structure, and to enable more accurate assessment of the changes to the structure after the exposures to information.

A potential source of ambiguity arose with the variations of the same expressions from one exposure to the next. In asking girls to record their knowledge over a sequence of exposures, there was considerable repetition of knowledge. This led to a painstaking process of node matching to evaluate

whether two propositions from different structures were functionally equivalent. The comparison of expressions revealed some variations, even though procedures were set in place to minimise this, such as the girls having access to their own responses throughout the data gathering process. More often one node almost matched another. Some of these variations were detected by the researcher when analysing responses for the question answering stage, and were resolved by discussing these with the girls to determine if the statements were the same or not. In some instances, the researcher made the decision that statement nodes from one exposure which showed variations in terminology were considered synonymous if they had the same meaning or a functionally similar meaning. This was considered important in ensuring accurate generation of structures, and thus ensuring accuracy of the changes.

All empirically extracted statements were then translated into a single conceptual graph structure. Figure 9 illustrates part of a conceptual graph structure of one girl about the purity of heroin and its associated problems.

FIGURE 9
CONCEPTUAL GRAPH STRUCTURE



In this research, the statements acquired through the verbal protocols were combined with the free generation statements during the transcription

process to create a complete interrelated picture of each girl's declarative knowledge. While no interjudge comparisons were undertaken in this research, two independent attempts to segment the transcriptions into statement nodes were undertaken six days apart. There was high level of agreement between these two attempts, with only 7% variation in the assignment of statement nodes. The disputed statements were subjected to a third analysis some three days later to resolve the disparity.

The result of this translation process was a set a declarative knowledge structures for each girl at each stage. Each conceptual graph structure had imposed some organisation on the knowledge that was extracted, and was assumed to represent the true knowledge structure under consideration. It was recognised that it was neither perfect nor complete. However, it did appear to capture a sufficient amount of knowledge for considering how knowledge structures participate and interact in the information process, and what the impact of this interaction would be in terms of cognitive information utilisation.

In conclusion, it must be iterated that the declarative knowledge structures that form the basis of this study were in the context of a quasi-experimental approach that controlled for a number of frames of reference. In summary, these frames of reference included gender, school level, English language fluency, academic achievement, level of motivation for learning, domain knowledge to be investigated, task, timing of procedure, and the number, order, structure and content of the information exposures. These have implications for transferability of the findings, to be discussed in Chapter 6.

CHAPTER 4

DATA ANALYSIS

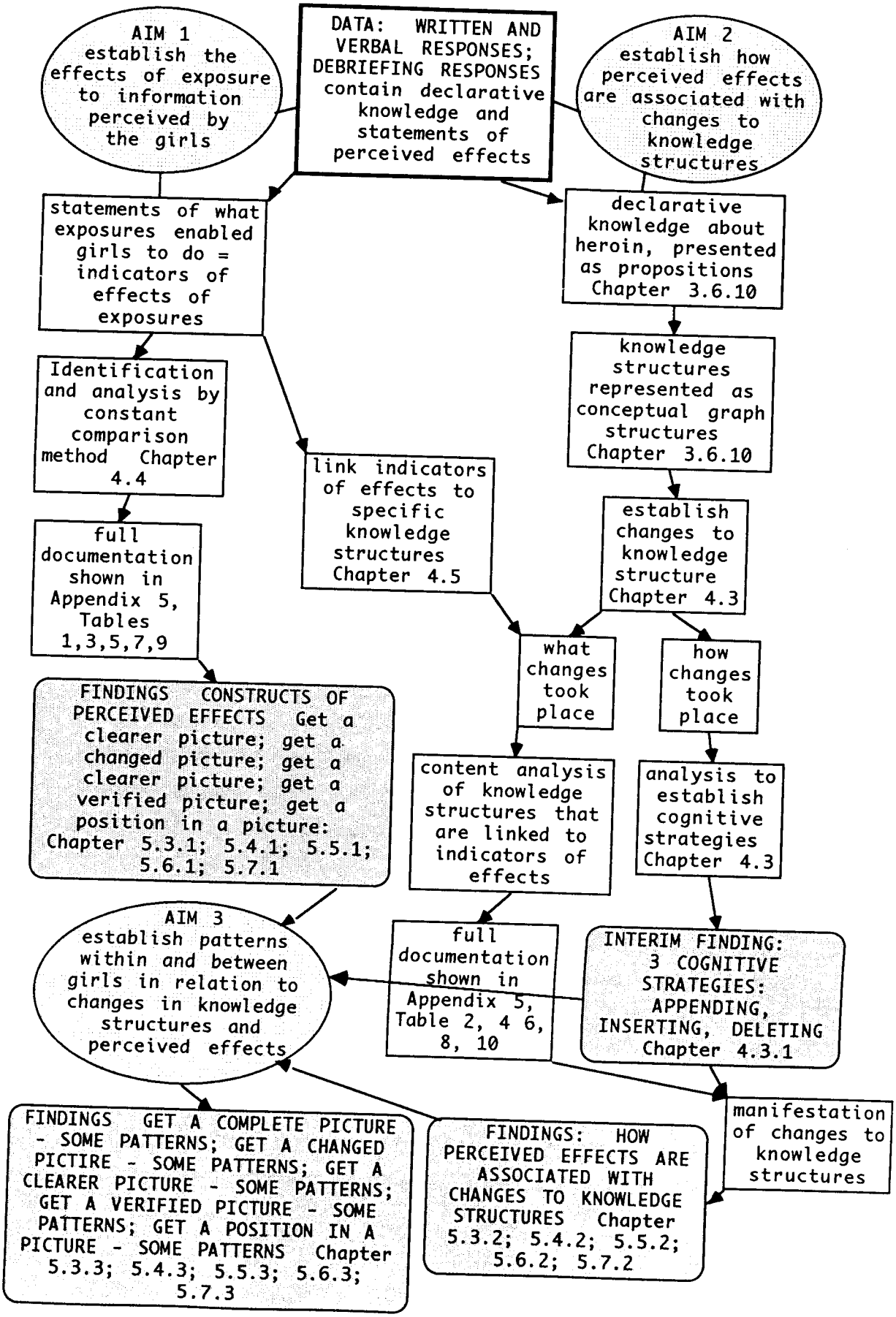
4.1 INTRODUCTION

This chapter discusses the data analysis techniques, and contains some interim findings of the analyses carried out in relation to each of the aims of the study. As already stated, the research sought to provide a richer understanding of concepts of cognitive information utilisation employing a quasi-experimental approach to collect the data. As established in Chapter 3, the collected data was to be analysed qualitatively. In order to meet criteria of credibility, dependability, confirmability and transferability, emphasis was placed on explicating and applying a systematic approach to establishing and refining the conceptual categories of effects and the nature of their associations. This was seen to be important in ensuring that the categories derived by the researcher reflected the perceptions of the girls, and that there would be sufficient basis for others to make judgements of the transferability of the findings.

4.2 DATA ANALYSIS TECHNIQUES: OVERVIEW

The data analysis consisted of three phases, each phase associated with one of the three aims of the research. Phase 1 focused on establishing the effects ΔS of exposure to information perceived by the girls (Aim 1). Phase 2 focused on establishing how the perceived effects were associated with changes to their knowledge structures. Changes to knowledge structures were examined in terms of *what* changes took place, and *how* these changes took place (Aim 2). Phase 3 focused on establishing some of the general patterns (Aim 3), based on the findings related to Aims 1 and 2. An overview of the data analysis process as it relates to the aims and findings is shown in Figure 10. Techniques for each of these phases will be discussed here.

FIGURE 10
OVERVIEW: AIMS, DATA ANALYSIS AND FINDINGS



4.3 PHASE 1: DATA ANALYSIS TECHNIQUES FOR ESTABLISHING PERCEIVED EFFECTS ΔS (AIM 1)

An analytical approach based on Miles & Huberman (1984) was employed to analyse the range of indicators provided in the data in order to build conceptualisations of effects and changes to structures. This approach centred on three concurrent activities: data reduction, data display and conclusion drawing. Because the data analysis did not begin with a priori theory, the data was analysed inductively, that is, from the specific raw units of information to subsuming categories. This was considered to be consistent with the study's focus on understanding cognitive information utilisation from the perspective of "the active-creative role of the user" (Wingens, 1990: 37).

The starting point in establishing the perceived effects ΔS was derived from the extensive range of indicators of the effects of the exposure to information on each girl's knowledge base as evidence of information utilisation. These indicators were derived from 2 sources in the data:

1. *written and verbal responses provided in the free generation and question answering sessions.* Particularly in the question answering sessions, the girls were encouraged to talk in conversational style, and to make comment as they wished. In applying the who, what, when, where, why questions, they supplied a rich collection of what Graesser & Clark (1985: 61) termed "meta nodes". Meta nodes are statements that refer to an embedded set of nodes or an embedded conceptual graph structure. They comment on or ascribe properties to the declarative knowledge as represented in the nodes and their interrelationships. For example, Girl #2 said: "I had previously thought that heroin was extremely harmful to one's health. Since reading the information I've changed my mind. Heroin is less harmful than alcohol". In this instance, the girl is commenting on a previously stated node "heroin is extremely harmful to one's health" and indicating that the new information has enabled her to change her mind about this statement. This has resulted in the replacement of this node with another node "heroin is less harmful than alcohol".

2. *debriefing session.* As part of the debriefing process, the girls were also asked to comment in a general way on how what they know has changed, and what the exposure to the information enabled them to do. To facilitate this they were asked the question "what did the new information enable you to do?" The indicators provided during this debriefing stage can be considered as a higher level of abstraction to the concrete indicators derived from the written and questioning procedures, as they are in a sense removed from the concrete indicators identified in the written and verbal responses.

The following steps were undertaken to organise and interpret these indicators:

1. *examination of transcripts* to isolate and extract the indicators of the effects of doing something cognitively with the information as found in the meta nodes.

2. *preliminary and intermediate counting of indicators.* Within a qualitative approach, counting served to establish the viability of identifying conceptual constructs. Collectively the girls provided a rich collection of statements on the enabling power of the new information as it interacted with their existing knowledge. Table 1 shows the number of indicators by source for each girl. A total of 141 indicators were appropriate to the study, with the majority (75%) being provided in the written and verbal responses. Girl #1, #2, and #3 provided a similar number of 37, 41 and 39 indicators, while Girl #4 provided considerably less with 24 indicators.

TABLE 1
NUMBER OF INDICATORS BY SOURCE

SOURCE	GIRL #1 *n*	GIRL #2 *n*	GIRL #3 *n*	GIRL #4 *n*	TOTAL *n*
Debriefing	11	7	9	7	34
written/verbal	26	34	30	17	107
TOTAL	37	41	39	24	141

n = number of indicators from each stage of the research for each girl

3. *preliminary noting of constructs.* This was based on examining the indicators derived from all four girls, rather than for each girl, in order to raise the level of abstraction of perceived effects. The first set examined were from the debriefing session. These represented a higher level of abstraction because they were not tied to any concrete examples, as were those found in the written and verbal responses. Some constructs stood out easily, for example "made changes to ideas" and "made better sense". Table 2 is a summary of the first attempt at clustering and developing researcher-derived constructs, based on indicators derived from the debriefing session. Eight preliminary constructs were established from the debriefing data. These preliminary constructs formed the basis for shaping the constructs that were to finally emerge as the findings of the study related to Aim 1.

TABLE 2
PRELIMINARY CLUSTERING OF DEBRIEFING INDICATORS

DEBRIEFING INDICATOR	COMMENT	CONSTRUCT
• The information told me some things I already know. I guess it tells me I was right • I doesn't change some things I know.	acknowledges that new information matches knowledge already known; confirms existing knowledge	CONFIRMED EXISTING KNOWLEDGE
• I now know a lot of things I didn't know before • I got a lot of new information from the sheets • got a more complete picture • I learned a lot of new information • it gave examples - made concrete some of the general things I've said • you realise how much you didn't know	these indicators suggest that exposure to new information enabled getting more information; getting knowledge; they express an increase in the size / extent of knowing ; the getting of specifics - getting of more knowledge concern with the magnitude of knowing - more or less	GOT INCREASED KNOWLEDGE GOT MORE KNOWLEDGE?

TABLE 2 (continued)
PRELIMINARY CLUSTERING OF DEBRIEFING INDICATORS

DEBRIEFING INDICATOR	COMMENT	CONSTRUCT
• it corrected something that was wrong - corrected facts • I've changed my mind many times - new facts showed that some of my facts were wrong, which I changed • it corrects what is wrong; you thought something before and it isn't right • I found some of my ideas were wrong, so I changed them • you can change your mind • you can get your facts right	embedded here is the making of a judgement about the correctness of the ideas - an initial process of confirming and disconfirming, sometimes then replacing the incorrect ideas with the new, correct ideas as part of the change; also the implication of change these suggest changes are made to knowing implies a process of correcting if facts are wrong - after some comparative process to see if facts are right	MADE CHANGES TO IDEAS
• I'm able to make a conclusion; that is I can put all the ideas together and make a general statement • I can state a personal viewpoint • I'm able to look at heroin from different sides rather than having a narrow fixed view; see different viewpoints • you can develop your own view where you stand in relation to an idea	reaching a judgement or opinion - making a final statement; to arrive at a termination; deduction - based on the collective knowing; acknowledging multiple perspectives - contextualising these seem to be all end-point ideas	ABLE TO STATE A VIEWPOINT

TABLE 2 (continued)
PRELIMINARY CLUSTERING OF DEBRIEFING INDICATORS

DEBRIEFING INDICATOR	COMMENT	CONSTRUCT
• it confirms some of the guesses I've made, like when I started writing the first time, you know something but are not certain ... then information tells you that it is • it confirms what I already know, especially when you think something though you're not feeling 100% certain • it sort of gives more certainty to what you think; that's a general thing; it confirms my own ideas	there appears to be some stating of the facts, even though respondents not entirely certain about the accuracy of the facts; the new information enables respondents to be more certain about their facts - that they are correct; the new information tells them that what they already know is OK - the doubt is removed: surety?	GOT MORE CERTAIN ABOUT IDEAS this involves some notion of confirmation
• I could sort out my fuzzy ideas • it helps to clarify things I didn't understand before • it gives you background information that helps clarify the picture	there is some confusion; some lack of discernment, or clarity the new information helps to illuminate; shed light on ideas and their relations so that ideas are seen more clearly	MADE BETTER SENSE
• it triggered other information I already knew; the information was not remembered the first time round • I was able to make connections	able to recall information that existed in memory but not initially recalled in present context; new information activated recall chunks of information now isolated were linked together	ESTABLISH LINKS

TABLE 2 (continued)
PRELIMINARY CLUSTERING OF DEBRIEFING INDICATORS

DEBRIEFING INDICATOR	COMMENT	CONSTRUCT
• gives more reasons for something; makes a stronger argument; makes it more convincing • it strengthens my ideas - like the importance of drug education • gives evidence for some of your ideas - specific facts to back up what you are saying • you can qualify what you know, you can give reasons • you have the arguments you can use when you are discussing the drug with someone • you can comment on an idea with a bit more certainty, conviction - that's because you have more correct facts • enables me to build a stronger case that in my own mind I won't take drugs • present a more accurate argument	the new information here seems to play a role of providing greater support, weight or strength or conviction. It provides an evidential base, a support and back-up in developing a stronger case	STRENGTHENS POSITION DEGREE OF CERTAINTY

4. *Analysis of the indicators in the verbal and written cues.* This was then undertaken to establish the plausibility of the preliminary constructs (Miles & Huberman, 1984). This was done by:

(a) formal clustering of indicators derived in the written and oral stages of knowledge acquisition to conceptualise similar patterns or characteristics. This was undertaken by using "constant comparative method" (Glaser & Strauss, 1967), an interactive process of comparing and aggregating pairs of indicators. Essentially this involves sorting units into provisional categories on the basis of "look-alike" characteristics, and articulating propositional statements that serve as a basis for

inclusion / exclusion decisions. The categories thus are defined by the collected data rather than imposing on the data pre-existing categories.

(b) subsuming the particular "effects" in more abstractly defined classes to establish the highest level of abstraction to meaningfully contain the indicators. This process also enabled the identification of sub-categories within more general classes.

(c) using preliminary constructs to test for further plausibility testing and comparison, so as to test the adequacy and completeness of the constructs embracing all the indicators.

(d) generating appropriate metaphors for the constructs that give meaning to the particulars and provide a richer basis for exploring theoretical possibilities.

Based on these procedures, a number of changes were made to the preliminary constructs. For example, the preliminary constructs "got more certain about ideas" and "confirmed existing knowledge" were seen to be part of a more general verification continuum, and subsumed into the more appropriate category of verification.

An important aspect of data analysis was confronting the questions of confirmability and dependability. Consequently, a number of procedures were put in place to address these concerns:

(a) developing expertise with assistance of experienced qualitative researcher in constant comparison approach to developing conceptual constructs and getting feedback on the theoretical constructs.

(b) undertaking the constant comparison approach on three separate occasions, with at least one week separating the attempts. This was done to check the stability and plausibility of the categories over time, and to deal with problematic indicators. The first was an initial sweep of all the indicators using the constant comparison method to get a sense of the

data; the second, a week later, was to develop constructs based on the more general indicators from the debriefing session, followed by the processes as documented above; the third, some ten days later, repeated the process. In this repeat process, there was substantial agreement as to the categorisation of the indicators; the third attempt dealt with the remaining small number of indicators where there was some difficulty. Some of these were subsequently placed in various categories, with the exception of a few that remained uncategorised. Those uncategorised appeared to fall into two groups: no effect of the exposure; and artefacts of the research methodology. The artefact category was made up of the indicators of ways of managing the volume of information because of the recording process and repetition of information. These indicators were not subsequently included in the approach to developing the conceptual constructs of the perceived effects. Examples of these indicators are shown below:

<u>no effect</u>

- I haven't stopped knowing all that I've written or said before
- I still know all the other, and it hasn't changed with this information

<u>research artefact</u>

- I haven't changed what I know. It takes a long time to write it down, that's why I'm mentioning it to you so you realise I still know all that I wrote before
- summary. I can still remember all of the detail; it's easy to write down what you know this way

The outcome of this constant comparison approach was the conceptual constructs of the perceived effects. These represent the answer to the first aim of the study: to establish the perceived effects of exposure to information by the girls. This outcome is documented in Chapter 5.

4.4 PHASE 2: DATA ANALYSIS TECHNIQUES FOR IDENTIFYING ASSOCIATIONS OF PERCEIVED EFFECTS AND CHANGES TO KNOWLEDGE STRUCTURES (AIM 2)

The approach taken to identifying and conceptualising the changes to the girls' knowledge structures was based on analysing the actual knowledge structures of the girls generated through the graphing procedures outlined in Chapter 3.6.10. For the purposes of this study, a knowledge structure was defined as a set of at least two or more propositions stated by the girl about heroin linked together by some relation, and / or a single proposition linked to some implicit organising concept. A change in structure was defined as an alteration to the initial structure in some way. Change was characterised in two ways. Firstly, it was characterised as *how*, that is, understanding the cognitive strategies operating on knowledge structures to bring about the revised structures. Secondly, it was characterised in terms of *what*, that is, describing the nature of the revised knowledge structures resulting from the cognitive strategies.

4.4.1 Cognitive strategies operating on knowledge structures

Data analysis to establish the cognitive strategies was undertaken by the following steps:

1. *identify and isolate propositions, and construct conceptual graph structures.* As a result, large macrostructures were generated to represent the declarative knowledge of each girl about heroin. For each girl, four large conceptual graph structures were constructed to represent the knowledge structure prior to the first exposure to information, and after each of the three exposures. All conceptual graph structures were generated using KMap, a software program developed by Gaines & Shaw of the University of Calgary, Canada, and publicly available for down loading from the Internet website: *http://www.ksi.cpsc.ucalgary.ca/articles* through file transfer protocol. This is a simple graphical program to facilitate the presentation of nodes and linkages.

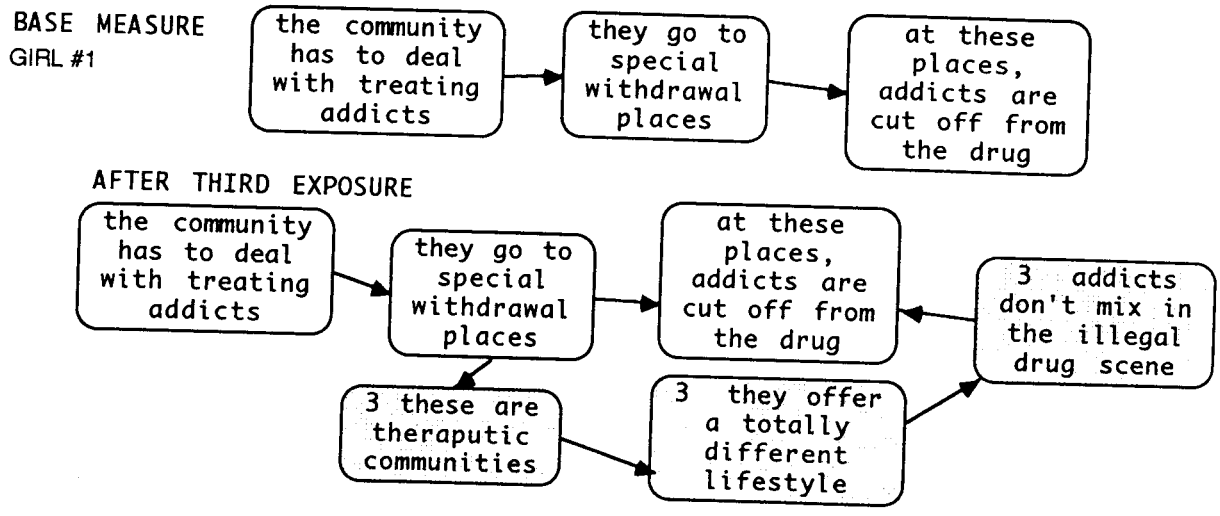
2. *establish working substructures.* Originally it was planned to present as part of this report the complete conceptual graph structures at each stage of the process for each girl. This was problematic for a number of reasons. Some of the transcripts contained sensitive and personal information, that if presented, could raise ethical implications. The conceptual graph structures were also very large, with each containing more than 150 nodes and relations, and a single graph was thus very congested. Consequently, the representations were broken down into smaller structures based on the three organising concepts expressed in the hypothetical task: "*Nature and incidence of the drug*", "*Implications for the individual*" and "*Implications for the community*". It was clear from the girls' transcripts that they made definite attempts to organise their knowledge around these organising concepts, as shown in their propositions such as: "heroin affects the community", "one of the major impacts on community is the need to provide for treatment of heroin addicts", and "a major factor for individuals is the reasons why people take drugs". In a number of cases, the girls also provided summary headings in their written transcripts, such as "reasons for drug use", "origins", "treatment", and "effects of taking heroin". These headings were also used as organising concepts for their ideas. Each of these smaller structures contained a considerable amount of repeated information, unchanged from one exposure to the next. It was also felt that since the focus of the study was on effects and changes, these changes should be featured, without the bulk of the unchanged information being presented.

3. *systematic comparison of the structures of each girl across the different exposures.* This served to isolate all instances of changes in structures. The conceptual graph structures provided a convenient visualisation of the changes, and from this visualisation, the nature of the changes could be derived. A potential problem in undertaking this was related to the requirement of "writing down all you know". It was a task that took time, and in all cases, very repetitive. The girls had available to them their complete transcripts and the stimulus material. Two of the four girls were quite meticulous in rewriting / repeating all that they knew, and took considerably longer time to write down their knowledge. The other two girls

demonstrated some coping mechanisms, such as "I haven't changed what I know. It takes a long time to write it down, that's why I'm mentioning it to you so you realise I still know all that I wrote before" and "summary: I can still remember all of the detail; it's easy to write down what you know this way". In these cases, previous knowing was regarded as a part of existing knowing. While this process may not have recorded explicitly all of the existing knowledge, it captured sufficient number of changes to ensure workability of the approach and testing of the ideas. The question answering stage was also used to establish similar / equivalent propositions from one exposure to the next. Each girl clearly brought a sense of her own internal consistency to the process.

4. *document all instances of changes to structure.* The changes that were identified were isolated. Surrounding nodes other than those involved in changes were often included in documenting the changes so as to situate the change in a larger and more meaningful context. This also facilitated the presentation of multiple changes to structure that were occurring sometimes in parallel, sometimes overlapping, sometimes sequentially. This varied according to the knowledge identified by each girl. Each individual instance of change of structure was thus documented. An example of this documentation is shown in Figure 11.

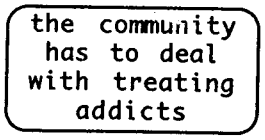
FIGURE 11
CHANGE IN KNOWLEDGE STRUCTURE



In this example, the existing knowledge consisting of three propositions has been extended by a further sequence of three propositions (shaded) after the third exposure. For the purposes of reading and interpreting this, and subsequent, conceptual graph structures, the following coding was used:

The girls are labelled Girl #1, Girl #2, Girl #3, and Girl #4.

The boxes are nodes containing propositions. For example:

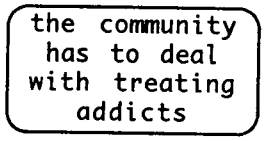


represents a node.

The lines represent conceptual relations between propositions. The arrowhead indicates the direction of the flow of ideas, as provided by the girls.

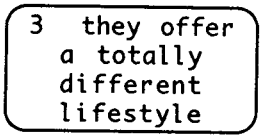
OC specifies an Organising Concept.

Nodes without numbers represent the existing knowledge structure prior to exposure to information, referred to as the "base measure". For example:



This node containing the proposition "the community has to deal with treating addicts" was provided as part of existing knowledge prior to any information exposure.

Numbers 1, 2, 3 preceding the statement in a node, indicate the stages of the exposure. For example, in the following node

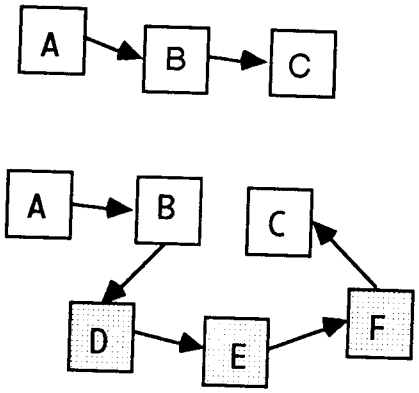


the statement "3 they offer a totally different lifestyle" was presented after the third exposure to information, as indicated by the inclusion of "3".

Shading is used to draw attention to particular aspects of conceptual graph structure under discussion.

This surface structure of linked propositions was then converted into a generic conceptual graph structure so as to enable the change processes operating on the structure to stand out more clearly. This is shown in Figure 12. It shows quite readily that a sequence of three linked nodes labelled D, E, and F has been included to form a new relation between nodes labelled B and C.

FIGURE 12
GENERIC CHANGE PROCESS



5. Once the generic processes were documented, a systematic comparison of the patterns was undertaken to identify categories of change strategies. This was guided by the framework of change strategies posited by Graesser & Clark (1985) as presented in Chapter 2.14.1

4.4.2 Phase 2 outcomes: cognitive strategies operating on knowledge structures

Based on the above analysis to establish how the knowledge structures were changed, three generic cognitive strategies were identified. The girls make changes to their knowledge structure by appending, inserting and deleting information. Each strategy is discussed in turn.

4.4.2.1 Appending

An appending is an adjustment of addition, where a new node or a new structure of nodes and relations is attached to an existing node in the structure by a new relation, or to an organising concept around which a structure is being built. The cognitive strategy of appending is operationally represented in Figure 13, showing node F attached to existing node C.

FIGURE 13
THE COGNITIVE STRATEGY OF APPENDING

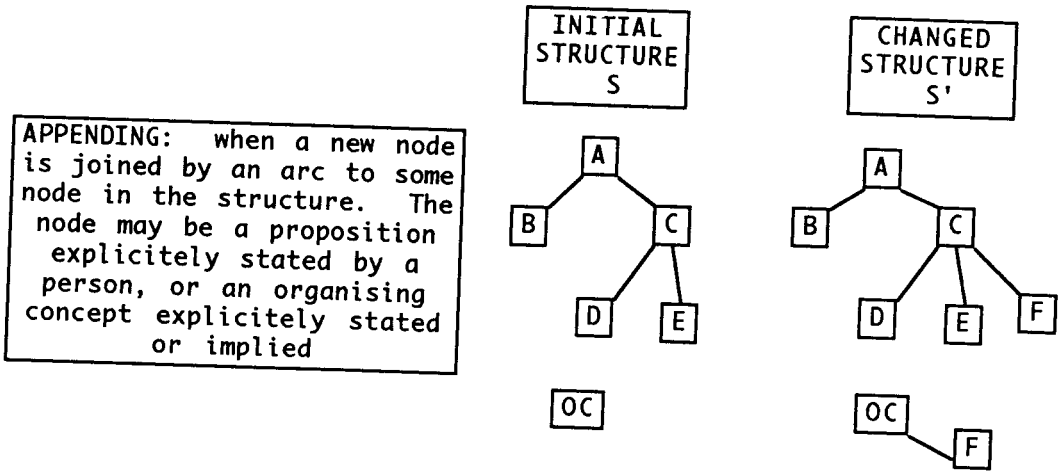
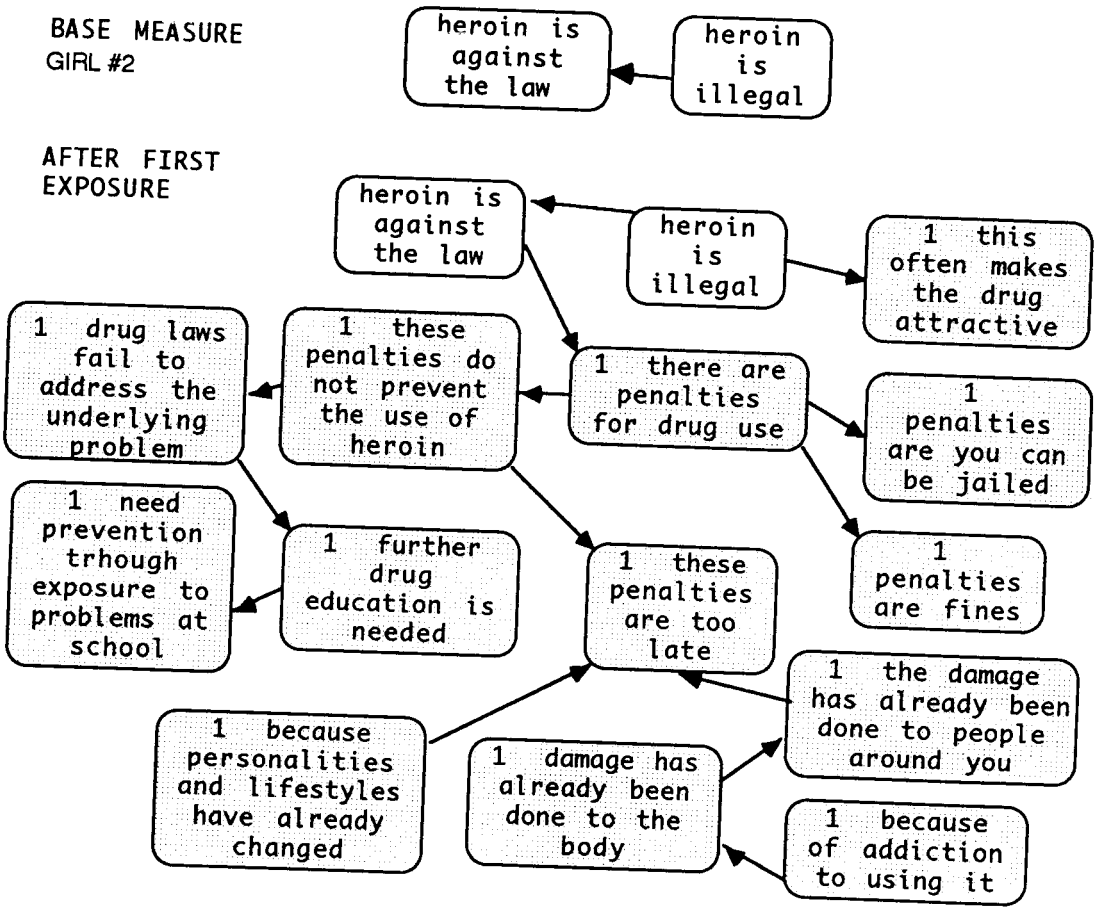


Figure 14 is an example of appending. In this example from Girl #2, after the first exposure, the node consisting of the proposition "this often makes the drug attractive" has been joined by an arc to the existing node consisting of the proposition "heroin is illegal". The joining of the node to an existing node indicates the addition of the node and relation to the structure. The relation embedded in the arc is one of consequence, suggesting that the consequence of heroin being an illegal drug is its appeal. This is an example of a simple appending, that is, an appending that involves only small number of nodes.

FIGURE 14
CONCEPTUAL GRAPH STRUCTURE SHOWING APPENDING

A more substantial appending as part of the same knowledge structure is shown in Figure 15. The appending in this example is the appending of a substructure consisting of 12 nodes and 12 relations appended to the node "heroin is against the law". This appended sequence of ideas leads to two conclusions "these penalties are too late" and "further drug education is needed".

FIGURE 15
CONCEPTUAL GRAPH STRUCTURE SHOWING APPENDING



4.4.2.2 Inserting

Inserting is a more complex adjustment to the structure, where a node and two relations or a sequence of nodes and relations are placed between two existing nodes and their relation. The existing relation may remain, or may be deleted. The cognitive strategy of inserting is operationally represented in Figure 16:

FIGURE 16
THE COGNITIVE STRATEGY OF INSERTING

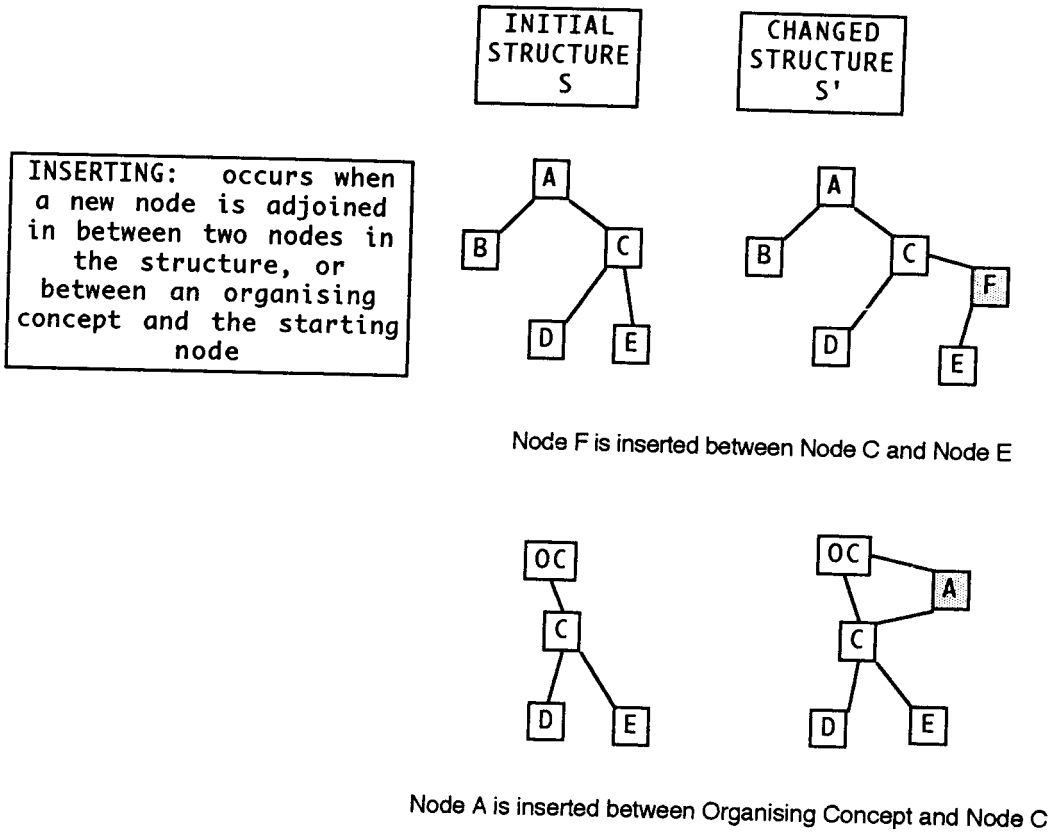


Figure 17 shows an example of inserting. In this example by Girl #1, three nodes and four relations have been inserted between the nodes with the propositions: "they go to special withdrawal places" and "at these places, addicts are cut off from the drug". This example is a simple inserting.

FIGURE 17
CONCEPTUAL GRAPH STRUCTURE SHOWING INSERTING

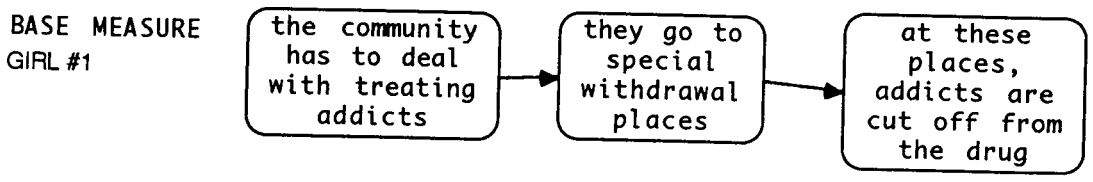
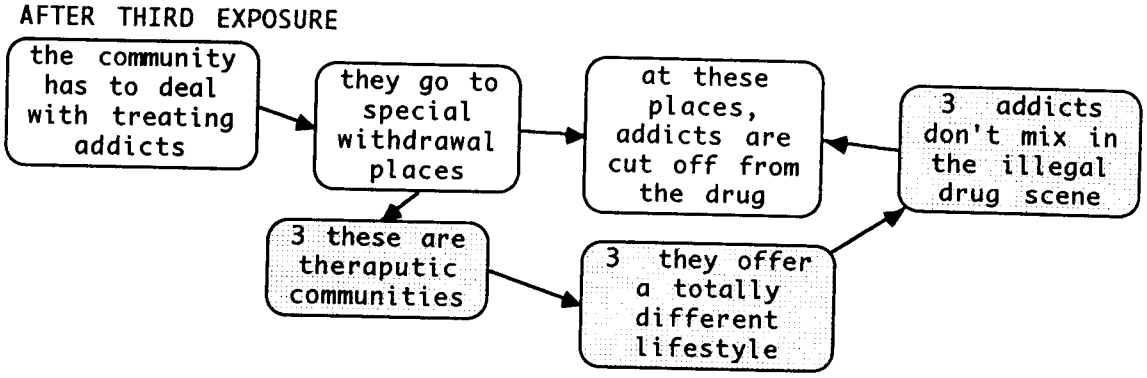
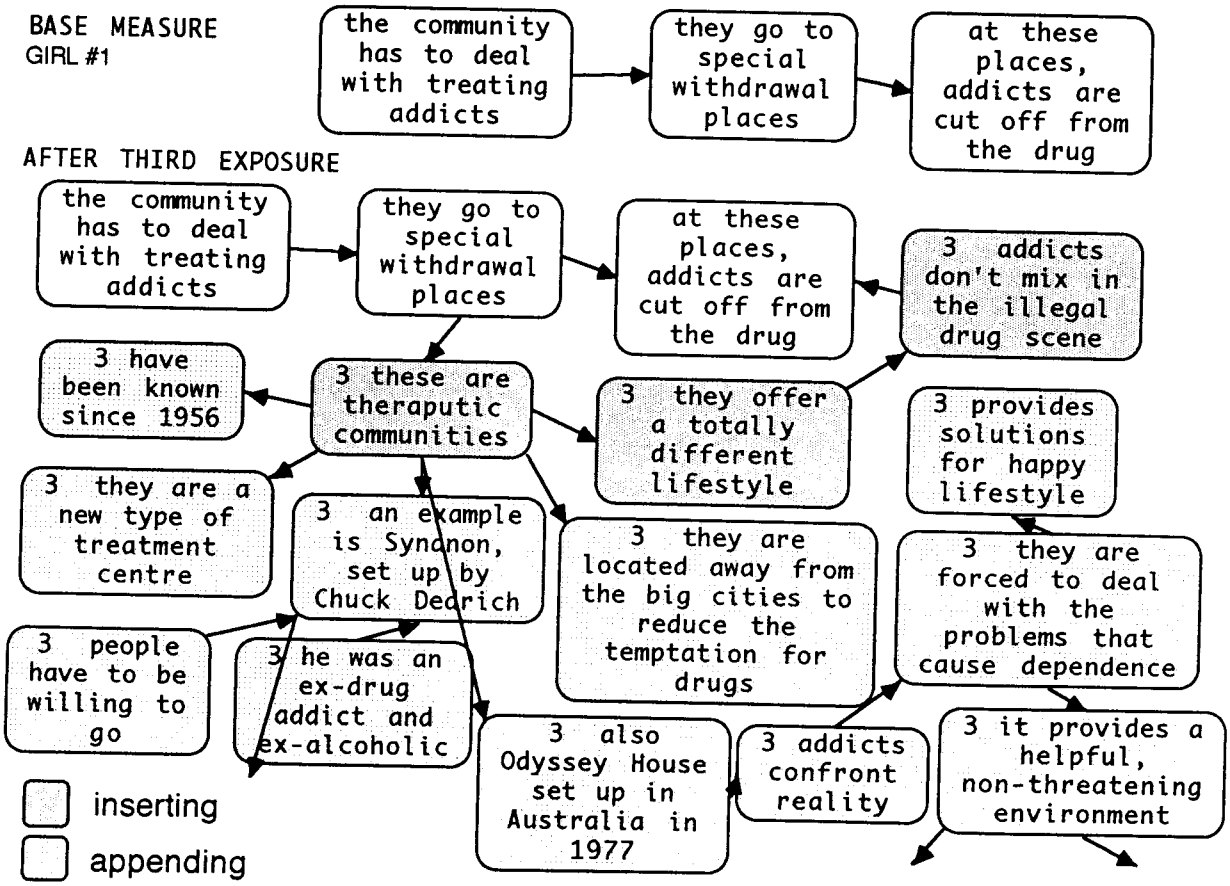


FIGURE 17 (continued)
CONCEPTUAL GRAPH STRUCTURE SHOWING INSERTING



Insertings may be more complex, when nodes that form a part of the inserting have other nodes appended to them, as shown in Figure 18. The shaded nodes in this conceptual graph structure show appendings after the inserting change has taken place.

FIGURE 18
CONCEPTUAL GRAPH STRUCTURE SHOWING APPENDING AFTER INSERTING



4.4.2.3 Deleting

Deleting is where a node and its relation are removed from the structure. Other nodes and relations already attached to the deleted node may also be removed in some instances, or they may be repositioned elsewhere by appending or inserting in the structure. Often deleting a node, brought about by realising that the node is incorrect or inappropriate in the structure or by the discovery of a correct node, is replaced by another node. This does not necessarily mean that the deleted node is removed from memory. It is possible that a given node may be deleted from a knowledge structure, but nevertheless be stored in memory and subsequently recalled as a proposition at some other time. It is acknowledged that part of a person's knowledge is knowledge that a proposition may be incorrect. The cognitive strategy of deleting is operationally represented in Figure 19:

FIGURE 19
THE COGNITIVE STRATEGY OF DELETING

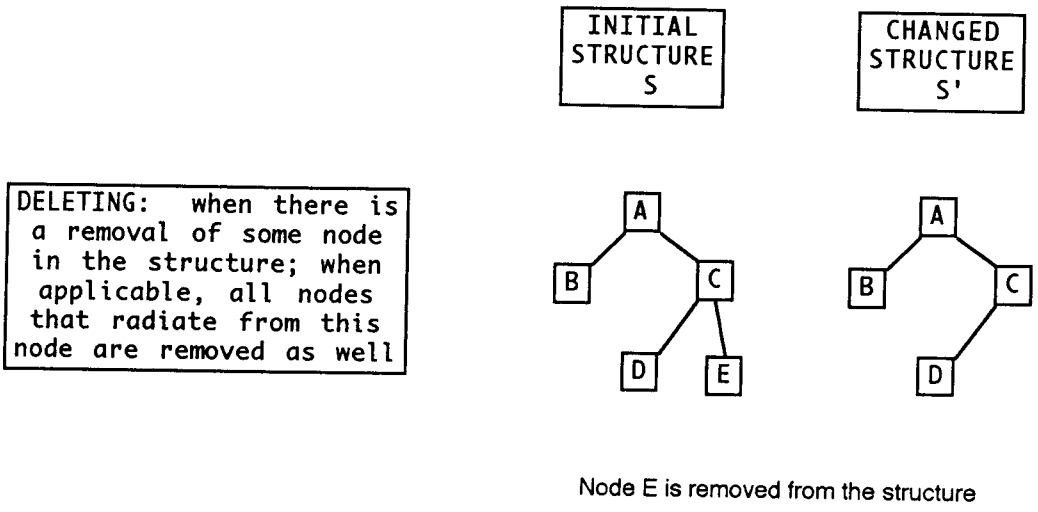
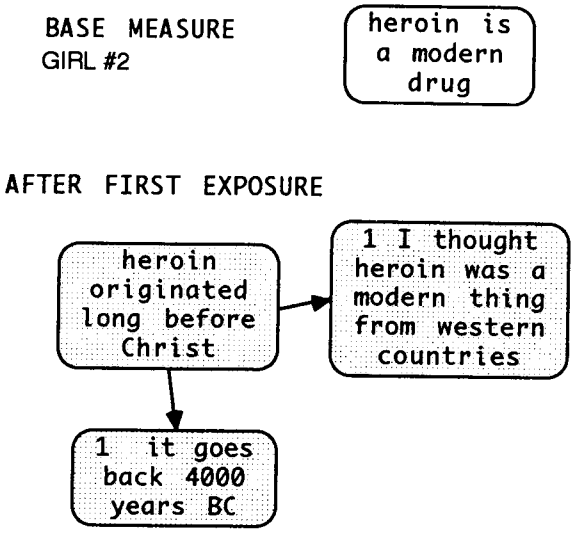


Figure 20 shows an example of deleting. In the base measure, Girl #2 indicated that "heroin is a modern drug". This node was subsequently deemed to be incorrect and was deleted. It did not show in the knowledge structure after the first exposure. A new starting node "heroin originated long before Christ" replaced the deleted node. Appended to this new starting node was the node "I thought heroin was a modern thing from western countries".

FIGURE 20
CONCEPTUAL GRAPH STRUCTURE SHOWING DELETING



In summary, the analysis of the changes in knowledge structures shows that the girls have changed their knowledge structures through appending, deleting and inserting. These were the cognitive strategies employed to bring about the changes to their structures. All girls showed evidence of using each of these strategies. For all girls, appending was the most frequently used strategy. These generic strategies of change show how a knowledge structure changes. In essence they show in a concrete way how a cognitive change is made to a knowledge structure. These strategies represent an interim stage of establishing the findings . They are an analytical tool in establishing how the perceived effects are manifested in changes to knowledge structure, and in interpreting the changed structures.

4.4.3 Establish how perceived effects are associated with changes to a girl's knowledge structure

Outlined below is the analytical procedure for establishing how the perceived effects of the exposure to information were manifested in changes to each girl's knowledge structure. It established the nature of the revised knowledge structures and the nature of their association with the perceived effects. This involved several strategies:

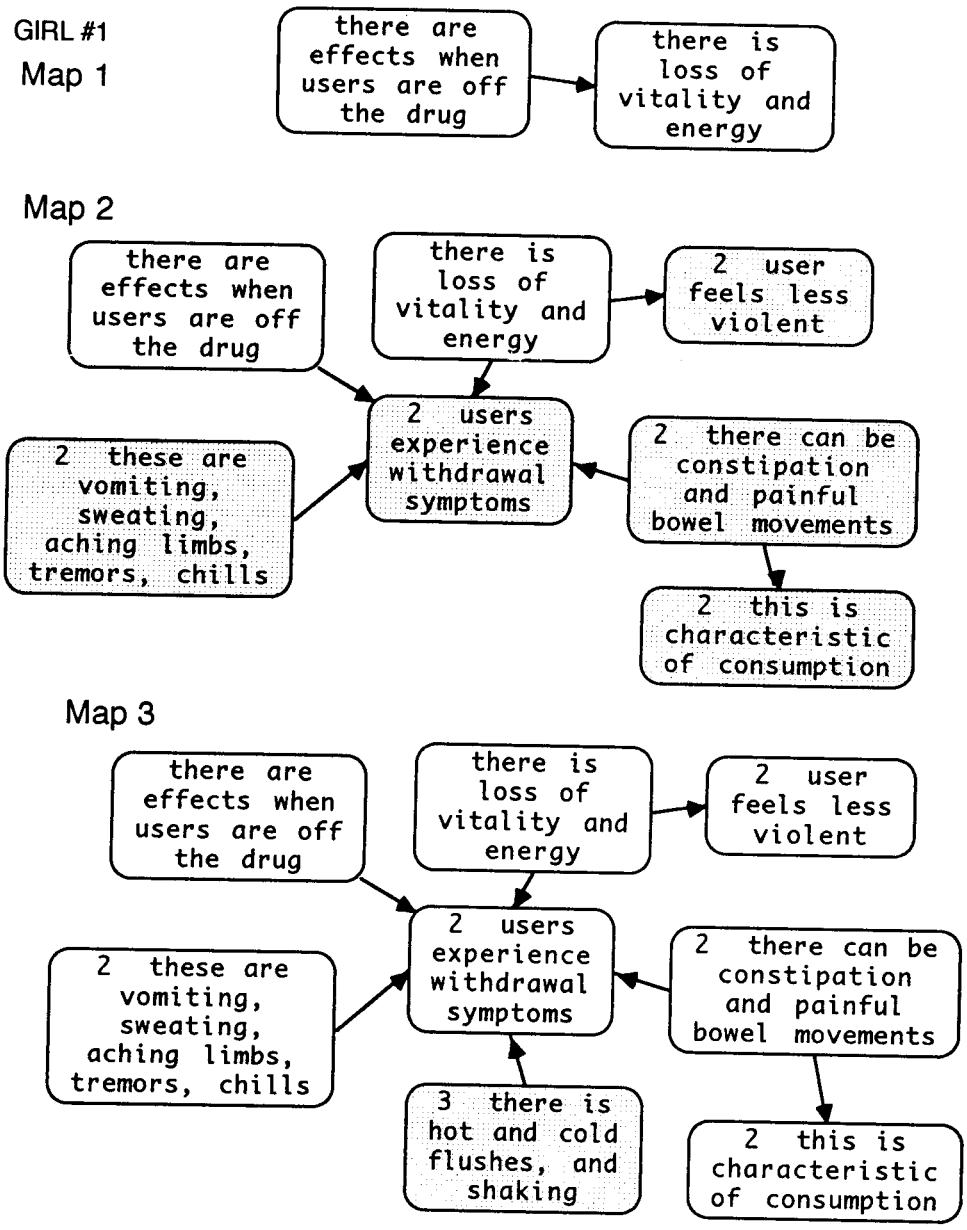
1. *linking a perceived effect to a knowledge structure.* The indicators of the perceived effects derived from the written and verbal responses were specifically linked to content areas. For example Girl #1 commented: "get a more complete picture: that's an expanded picture: you know more about an idea and what is related to it, for example, the reasons why people take drugs". This comment links the perceived effect of getting a more complete picture to content related to reasons for drug use. Girl #2 said: "the new information gave me specific examples to work with, such as examples of the specific effects. I didn't know all the specific effects before". This comment identifies content related to the effects of heroin use, and is tied to the effect of getting examples.

2. *isolating the conceptual graph structures for these content areas at each of the stages of the exposure.* The conceptual graph structures surrounding this content specification were mapped, first the existing knowledge, then changes to the content after the exposure. This resulted in a sequence of conceptual graph structures tied to a perceived effect.

3. *identifying the specific changes to the conceptual graph structures.* This was enabled by being able to identify instances of appending, inserting and deleting.

An example of this process is shown in Figure 21. It shows conceptual graph structures of Girl #1 in relation to the content of side effects manifest when users are off the drug (as opposed to when on the drug). Map 1 of the example shows her knowledge prior to any exposure (base measure). There are no changes to this structure after the first exposure. After the second exposure, shown in Map 2, a number of new nodes are joined to the structure. After the third exposure, an additional node has been appended, and no further changes have been made. Map 3 shows the complete knowledge and its structure for Girl #1 relating to side effects. Compiling series of maps for each of the girls enabled the changes to be analysed in order to establish how a perceived effect is manifested in changes in knowledge structure.

FIGURE 21
CHANGES IN A KNOWLEDGE STRUCTURE



For each of the girls, each of the content areas identified in indicators of the perceived effects was mapped, following the above strategies. This formed the basis for developing the constructs to characterise the changes to the knowledge structures. This proved to be a mentally taxing task. The process was undertaken through the following strategies:

1. *content analysis.* Content analysis was not done in terms of the rightness or wrongness of the content, rather, it focused on how the

ideas were linked together, and what was the nature of the coherent whole that was constructed because of the changes. Careful attention was given to the nature of the linkages, and this was guided by the taxonomy of relations established by Graesser & Clark (1985) that underpinned the verbal protocols, though not limited to this taxonomy. Understanding the nature of the links - consequence, implies, reason, outcome, initiate, manner, property, set membership - gave a sense of how the structures were changing, and what was the character of the changed structure.

2. *characterising the changed structures.* This was also guided by the framework established by Graesser & Clark (1985). They present a typology of conceptual graph structures. These include:

   (a) *cause-oriented structures*, consisting of a network of nodes which are interconnected primarily by consequence arcs;

   (b) *implicational structures*, consisting of a network of nodes involving syllogistic reasoning;

   (c) *goal-oriented structures*, consisting of a network of nodes interconnected by reason, outcome and initiate arcs;

   (d) *property-oriented structures*, consisting of a network of nodes that are connected by static descriptions of an event, state, or spatial characteristics;

   (e) *manner-oriented structures*, consisting of nodes that specify style, plans, and processes; and

   (f) *class inclusion structures*, consisting of a network of nodes that illustrate set-membership, (Graesser & Clark, 1985: 61-75).

These characterisations are seen as guidelines only; the characterisations established will be derived from the analysis of the changed structures provided by the girls.

3. *systematic recording of ideas.* The following proforma was created in order to keep track of the ideas and the emerging constructs, and a proforma was completed for every indicator of an effect tied to some specific content:

Case Number	a sequential number assigned to each indicator for a girl;
Source	location of conceptual graph structure in the researcher's computer data base;
Indicator	actual statement of the indicator of effect and its related content (declarative knowledge);
Conceptual graph structures.	actual C.G.S's are shown;
Effects category	conceptual construct assigned to the indicator of perceived effect;
Description	brief description of the content of the conceptual graph structure;
Structure comparison and analysis	describes all changes in relation to the content at each level of the exposure
Summary	presents the changes in the knowledge structure at a more abstract level

An example of the complete documentation of an analysis is found in Figure 22 using this proforma.

FIGURE 22
EXAMPLE OF COMPLETED PROFORMA

CASE #1.1 (GIRL 1)

Source: I INDIVIDUAL.4 (top); I INDIVIDUAL.4a

Conceptual Graph Structures:

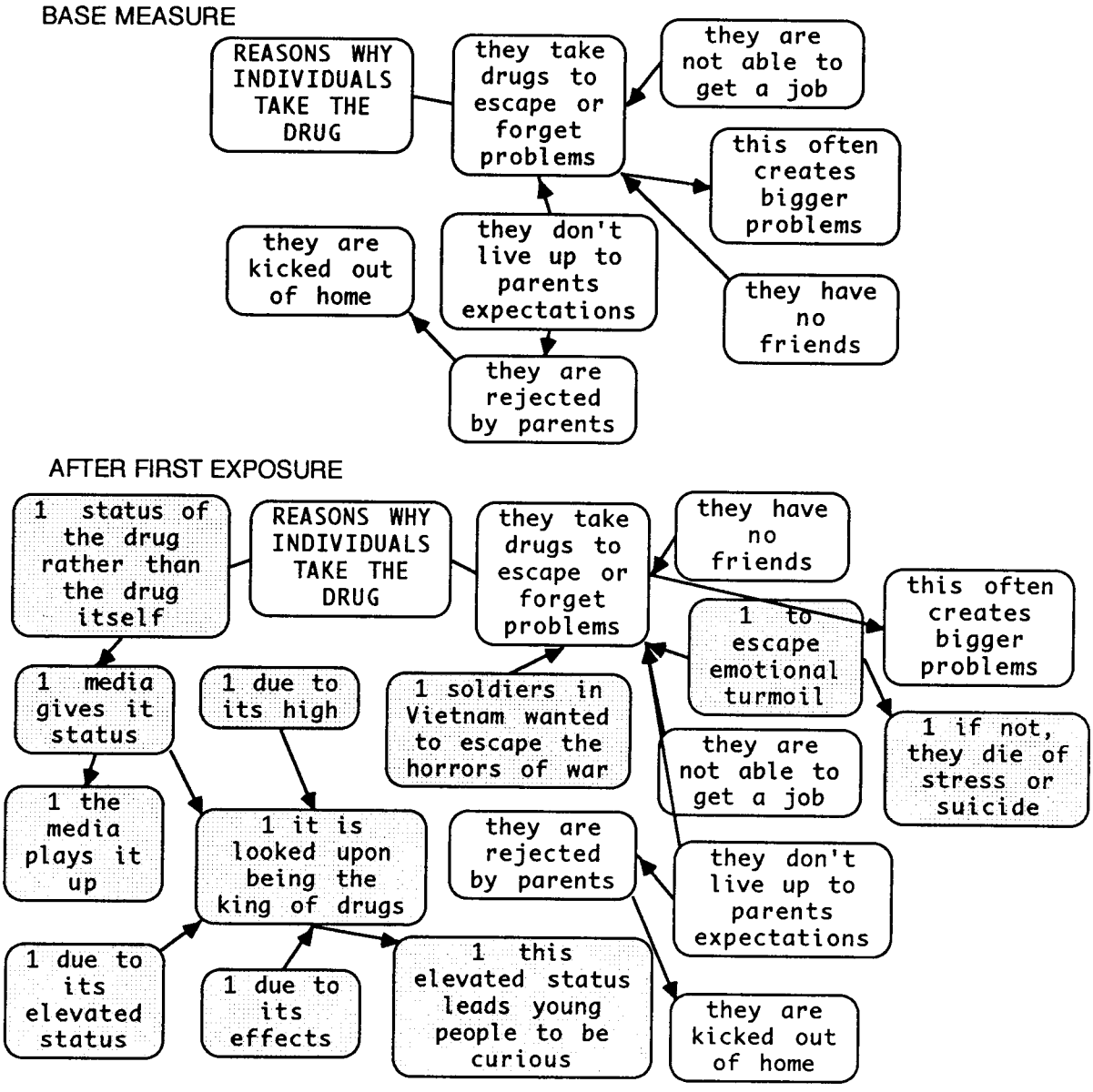
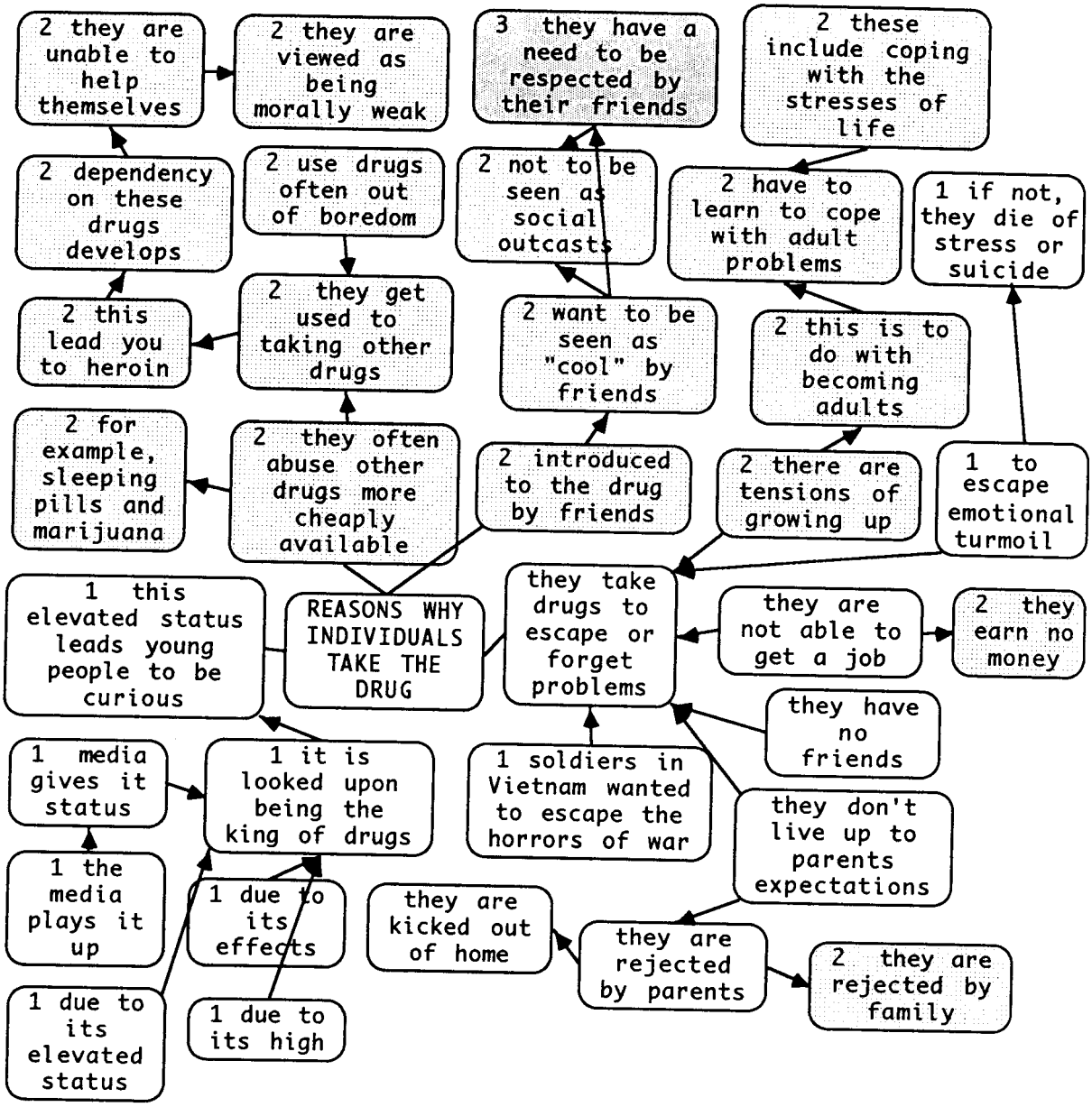


FIGURE 22 (continued)
EXAMPLE OF COMPLETED PROFORMA

AFTER SECOND and THIRD EXPOSURES



One change was made after the third exposure (heavy shading).

Indicator: "get a more complete picture: that's an expanded picture: you know more about an idea and what is related to it, for example, the reasons why people take drugs"

Effects category: get a complete picture

Description: The content of this structure is based on reasons why individuals take the drug, and is part of the structure on "Implications for the individual". The

FIGURE 22 (continued)
EXAMPLE OF COMPLETED PROFORMA

focus appears to be on building up a cause-oriented structure that provides specific reasons for heroin use. The initial structure is constructed around the proposition "they take drugs to escape or forget problems", and consists of a number of types of problems. As indicated in the changed structure, a number of change processes appear to have taken place that have enabled the respondent to perceive the stated impact. The change processes enable the expansion of the knowledge structure involving one reason why individuals take heroin to a picture that involves four elaborated reasons.

Structure comparison and analysis:

LEVEL: Base measure -> 1st exposure

(a) the proposition "soldiers in Vietnam wanted to escape the horrors of war" is appended to the established proposition "they take drugs to escape or forget their problems", and is derived from the information in the first exposure relating to the history of the drug in Australia, and particularly Australia's involvement in the Vietnam War. It enables the respondent to identify and add an example of "escape or forget problem", expressed as a reason why people take drugs.

(b) appended to the proposition: "they take drugs to escape or forget their problems" are two nodes that identify "escape emotional turmoil" as a specific type of "escape or forget problems", and state a possible consequence. These form part of elaborating the set membership of "problems" as a reason why people take drugs.

(c) a small cause-oriented substructure around the idea of the "status" of heroin is appended to the organising concept "reasons why individuals take the drug". This appears to elaborate the concept "status" by defining it and establishing the contributing factors.

LEVEL: 1st -> 2nd exposures

The changes between the 1st -> 2nd exposures show appending as the principal mechanism of change, all outcomes of the 2nd exposure. The overall effect is the expansion of the organising concept, enabling the articulation of multiple reasons why people take heroin, and the provision of examples of instances of causes.

(d) an appending attached to the organising concept, commencing with the proposition "they often abuse other drugs more cheaply available", establishes a reason, and provides a sequence of events that leads to the drug use. This sequence is close to the sequence of ideas presented in the exposure material.
(e) an appending is attached to the organising concept that commences with the proposition "introduced to the drug by friends". Part of this appending are the reasons why "friends" influence then to take drugs - "want to be seen as cool" and "not to be seen as social outcasts".

(f) the appending of the proposition "there are tensions of growing up", followed by its elaboration, to the proposition "they take drugs to escape or forget their problems" provides a specific type of "problems". This expands the more inclusive proposition through set membership.

(g) the appending of the proposition "they are rejected by family" to "they are rejected by parents", is a minor addition which broadens the scope of the rejection.

(h) the appending of the proposition " they earn no money" to "they are not able to get a job" is a minor addition, specifying an outcome.

FIGURE 22 (continued)
EXAMPLE OF COMPLETED PROFORMA

2nd exposure -> 3rd exposure

(i) there is an inserting between the propositions "want to be seen as 'cool' by friends" and "not to be seen as social outcasts". The inserting explains that being seen as "cool" is part of the need for respect by their peers, and that this is part of group identity, the alternative being "social outcasts". The inserting illuminates the interlinking of four important social concepts: "cool", identity, respect, and ostracism.

Summary: In getting "get a more complete picture: that's an expanded picture: you know more about an idea and what is related to it, for example, the reasons why people take drugs", the following changes take place:

case	no	level	cognitive strategy	change in knowledge structure
1.1	a	base -> 1	appending	add example (specific instance) of "escape" (concept in a proposition) cite real world instance: general -> concrete
1.1	b	base -> 1	appending	add specific type and its negative outcome to more inclusive node
1.1	c	base -> 1	appending	add new "reason" to organising concept "why take heroin" and elaborate with definition, causal factors and consequence
1.1	d	1 -> 2	appending	add new "reason" to organising concept "why take heroin" and elaborate with related sequence of events and specific consequences
1.1	e	1 -> 2	appending	add new "reason" to organising concept "why take heroin" and elaborate with explanation relating to goals
1.1	f	1 -> 2	appending	add specific type to more inclusive node "escape or forget problems"; elaborate with implicational statements
1.1	g	1 -> 2	appending	add more inclusive node to specific type specific -> general
1.1	h	1 -> 2	appending	add consequence to specific type
1.1	i	2 -> 3	inserting	add explanation to a relationship

The summary contained in the proformas provided the basis for developing the conceptual categories to describe the changes to knowledge structures associated with each of the perceived effects. In the case documented in Figure 22, the perceived effect of get a complete picture is established primarily by appending, and the changes structures primarily show developing set membership. Following this procedure, a set of abstract summaries was created for each of the perceived effect constructs.

3. Analysis of summaries to develop categories of change constructs. This followed the constant comparison approach as applied to developing the conceptual constructs of the perceived effects.

The outcome of this analytic process in Phase 2 was to establish the nature of the changes to the girls' knowledge structures, in terms of what changes took place and how these changes took place; and then to establish the nature of association between the perceived effects and the changed knowledge structures. The findings of how the perceived effects reassociated with changes to knowledge structures are documented in Chapter 4.3.2; 5.4.2; 5.5.2; 5.6.2; and 5.7.2.

4.5 PHASE 3: DATA ANALYSIS TECHNIQUES FOR ESTABLISHING PATTERNS (AIM 3)

Establishing the patterns of perceived effects, and their associations with changes knowledge structures, if any, within and between the girls was the final phase of the data analysis process. This was dependent on the findings derived in Phase 1 and Phase 2, and involved a comparison of these findings.

This decision process was also based on Miles and Huberman (1984), and involved systematic comparison of the type of effect, the number of effects, the distribution of effects across the different exposures, the type of changed knowledge structures, and the cognitive strategies of change. The findings emerging out of this comparison are documented in Chapter 5.3.3; 5.4.3; 5.5.3; 5.6.3; and 5.7.3.

CHAPTER 5

RESULTS AND DISCUSSION

5.1 INTRODUCTION

This chapter presents the results of the study and some discussion of these results. In accordance with the aims of the study, it establishes (1) the effects of exposures to information perceived by the girls; (2) how the perceived effects are associated with changes to their knowledge structures; and (3) the patterns within and between the girls in relation to the perceived effects and changes in their knowledge structures.

5.2 THE PERCEIVED EFFECTS: OVERVIEW

The girls in this study acknowledged that their working with the information in the exposures had an effect, and they were able to articulate quite specifically their perceptions of the exposures in terms of their effects. In the first instance, what was noticeable in many of their perceptions was their references to "picture". For example, some statements of effect were: "it broadens the picture", "I get more complete pictures", "it clarifies the picture" and "gives me an expanded picture". One girl further remarked: "In my mind I have scenes, images, many of them. I've described the pictures I've seen with words". Accordingly, the conceptualising and labelling of these perceived effects were based on the "picture" metaphor. Their expressions of "pictures" were in the context of some action of doing something with the information. In accordance with this, the picture labels were linked to the verb "get".

The analysis of the girls' statements about their perceptions showed that they perceived five effects of exposures to information. These were: (1) *get a complete picture*; (2) *get a changed picture*; (3) *get a verified picture*; (4) *get a clearer picture*; and (5) *get a position in a picture*. In the context of Brookes' Fundamental Equation, it can be said that these five effects

represent five types of cognitive information utilisation that took place as a result of the different exposures to information.

Table 3 shows the number of all the indicators of the perceived effects for each girl. These indicators were derived from the analytical procedure identified in Chapter 4.3. Overall, the girls provided substantially more indicators of *get a complete picture* (43) than the other perceived effects, with the least number of indicators for *get a verified picture* (17).

TABLE 3
NUMBER OF INDICATORS OF PERCEIVED EFFECTS FOR EACH GIRL

EFFECT	GIRL 1 *n*	GIRL 2 *n*	GIRL 3 *n*	GIRL 4 *n*	TOTAL *n*
get a complete picture	15	12	8	8	43
get a changed picture	7	7	8	6	28
get a clearer picture	6	2	12	4	24
get a verified picture	6	3	6	2	17
get a position in a picture	3	17	5	4	29
TOTAL	37	41	39	24	141

n = number of indicators of each perceived effect

Table 4 shows the number of indicators of the perceived effects identified in each knowledge elicitation procedure. For the four girls, the written and verbal responses provided substantially more indicators (107) than the debriefing session (34).

TABLE 4
NUMBER OF INDICATORS BY SOURCE

SOURCE	GIRL 1 *n*	GIRL 2 *n*	GIRL 3 *n*	GIRL 4 *n*	TOTAL *n*
Debriefing	11	7	9	7	34
written/verbal	26	34	30	17	107
TOTAL	37	41	39	24	141

n = total number of indicators provided by each girl by source

The results are organised around each of these five effects. Each will be discussed in turn. In accordance with the aims of the study, the discussion will commence with the concrete evidence of the indicators of the effects, it will define and discuss each effect, will examine how the effect was manifested in changes to the girls' knowledge structures, and identify some patterns associated with each effect.

5.3 GET A COMPLETE PICTURE

5.3.1 Description of *get a complete picture*

Table 3 (p. 179) shows that while *get a complete picture* was the most frequently occurring of the effects identified overall, and all the girls perceived this effect, it was the most predominant effect for Girls #1 and #4.

Table 5 shows the number of indicators of *get a complete picture* provided in the written and verbal responses and debriefing sessions. It was evident that there was some variation in the total number of indicators provided by each girl, as well as a variation in the number of indicators from each of the different exposures. Girls 1# and #2 (with 15 and 12 indicators respectively) had notably more indicators that Girls #3 and #4 (with 8 each). In all cases, the first and second exposures provided the most indicators, and the third exposure provided the least number with just one or two indicators of effects for each girl.

TABLE 5
NUMBER OF INDICATORS: GET A COMPLETE PICTURE

STAGES	GIRL 1 *n*	GIRL 2 *n*	GIRL 3 *n*	GIRL 4 *n*	Total *n*
DEBRIEFING	6	1	1	1	9
EXPOSURE 1	3	5	3	2	13
EXPOSURE 2	5	4	3	4	16
EXPOSURE 3	1	2	1	1	5
TOTAL	15	12	8	8	43

n = number of indicators of *get a complete picture* provided in written and verbal responses recorded after each exposure, and in the debriefing session

The construct *get a complete picture* was derived from the 43 indicators that were identified as conceptually similar through the constant comparison approach. Collectively these indicators suggested that the girls utilised the information to build an expanded, more complex picture. Some of the more general indicators from the debriefing sessions were statements like "I now know a lot of things I didn't know before"; "but I've learned a great deal more"; "It triggered some stories my mother told me"; "I found a lot of new information"; and "I was able to make connections". The written and verbal comments were more specific, and tied to particular content. Some of these indicators were: "it spells out all the side effects in detail. I learned many

specific effects I didn't know"; "learn whole new blocks of information - I didn't know anything about the history of drugs"; "the information put specific amounts on the fines and sentences"; "I learned a whole lot of new information about why people take heroin"; and "I didn't know before that heroin came from opium". A complete list of all of the indicators of *get a complete picture* for each girl is provided in Table 21 in Appendix 5.

From the indicators, it was inferred that *get a complete picture* took place in four ways. Firstly, the girls talked about how some of their general statements about a topic were expanded by more specific detail. This was reflected in specific statements such as: "it spells out all the side effects in detail. I learned many specific effects I didn't know"; "I've found out also that heroin comes in different forms"; "I wasn't aware before of all of the forms and details of treatment"; and "I learned a lot more about the detail of the specific effects. I wasn't aware of the specific effects of heroin as I hadn't realistically witnessed them". What appeared to be suggested here was the building up of a complete picture hierarchically, that is, where some of the girls' general knowledge was expanded with more specific detail and examples in the hierarchy of ideas.

Secondly, the girls talked about adding new facets or dimensions to an existing idea, or to an organising concept. This was shown in statements like: "I get a more complete picture: that's an expanded picture: you know more about an idea and what is related to it, for example, the reasons why people take drugs"; "I learned of the effects and its dangers"; and "learn whole new blocks of information - I didn't know anything about the history of the drug". What appears to be suggested here was building up an expanded picture by aggregating the various aspects of a topic into a complete picture.

Thirdly, the girls talked about making new connections between ideas that they didn't realise before. This is shown in comments like: "I was able to relate what I thought at first were unrelated ideas, for example, heroin, opium and morphine"; "I didn't realise heroin was connected to AIDS"; and "I knew that opium was used a long time ago, but I hadn't made the connection between opium and heroin. I always knew opium was connected to Asia and China". Here the girls seemed to be talking about making links between some of their knowledge about heroin, and other knowledge that existed elsewhere in the minds but not related to heroin.

Fourthly, some of the comments made by the girls suggested that the information seemed to act as a trigger to remembering and recalling ideas that already existed elsewhere in their minds that they hadn't thought of at the time. Some of the statements were quite explicit in this regard: "it triggered other information I already knew; the information was not remembered the first time round, such as my grandmother on morphine"; "that triggered my memory. I knew some of the effects of intravenous use, like hepatitis"; and "what was written triggered things I knew before but hadn't thought of at the time, like Coleridge and the subcultures". The information in the exposures seemed to provide memory prompts to bring back other knowledge into their current thoughts and attention, so as to further expand the picture.

What was also evident in some of their indicators was their ability to add not just single facts here and there to existing knowledge to expand it, but also to take in substantial amounts of information. This was reflected in comments such as: "all the treatment information was new" and "learn whole new blocks of information - I didn't know anything about the history of the drug".

In summary, from these indicators, it was inferred that *get a complete picture* happened when the girls utilised the information in the exposures to build an expanded, more complex picture of their existing picture about heroin. They appeared to utilise this information in a number of specific ways to build up the expanded pictures: they added specific detail to a more general picture; the added new facets or dimensions to an existing set of ideas; they made new connections to other knowledge previously not thought to be related to their knowledge of heroin; and they were prompted to remember more ideas. While it could be argued that all of the perceived effects described in this study ultimately resulted in an expanded picture where the person knew more, a complete picture for the girls was in the more immediate sense of building up an expanded picture about heroin. Cognitive information utilisation, expressed as the effect *get a complete picture* was in part a process of constructing new knowledge, and in part a dynamic process of making explicit links to recalled knowledge.

5.3.2 Manifestation of *get a complete picture* in changes to the girls' knowledge structures

This section of the results focuses on the study's aims (b) and (c) as presented in Chapter 1.2. It establishes how the perceived effect *get a complete picture* is associated with changes to the girls' knowledge structures, and identifies patterns. The analytical and comparative process undertaken to identify and conceptualise the cognitive strategies operating on knowledge structures is documented in Chapter 4.4. Based on this analysis, three generic cognitive strategies were identified - appending, inserting and deleting. As already established, these strategies were the basis for identifying how the perceived effects were manifested in changes in knowledge structures, and in interpreting and conceptualising the revised knowledge structures. The analysis techniques for undertaking this latter aspect are also documented in Chapter 4.4. In summary, this involved: linking an indicator of a perceived effect to its content, generating a conceptual graph structure for the base measure of this content; tracking this content over the three exposures; isolating specific changes created by appending, inserting and deleting; undertaking an analysis of the revised knowledge structures; and determining conceptualisations of the revised structures. For example, Girl #2 said "I got a whole lot of history information". This indicator of effect specifies the content area of the history of heroin. Her initial knowledge of the history of heroin based on her transcripts was mapped, and the subsequent knowledge structures on the history of heroin after each of the three exposures were then mapped. All instances of appending, inserting and deleting were identified, and the knowledge structures resulting from these changes were examined.

Table 6 shows the number and type of cognitive strategies associated with *get a complete picture.*

TABLE 6
NUMBER AND TYPE OF COGNITIVE STRATEGIES:
GET A COMPLETE PICTURE

COGNITIVE STRATEGIES	GIRL 1 *n*	GIRL 2 *n*	GIRL 3 *n*	GIRL 4 *n*	Total *n*
appending	24	11	11	11	57
inserting	3	2	2	4	11
Total	27	13	13	15	68

n = the number of instances of cognitive strategies identified

For all of the girls, appending was the primary cognitive strategy for changing their knowledge structures associated with *get a complete picture*, with 57 instances of appending identified in the comparison of the conceptual graph structures. Inserting was a secondary and comparatively minor strategy, with 11 instances. This pattern appears to be consistent across all of the girls. By these strategies, a single statement node or organising concept in their existing knowledge structures was expanded into knowledge structures with many statement nodes. Table 22 in Appendix 5 provides a full summary of the documentation associated with this analysis that has formed the basis of establishing the nature of the revised knowledge structures. It specifies the indicator of effect, the level where a change was indicated in the knowledge structure related to the content identified in the indicator (for example, "base -> 1" means that a change has been identified from existing knowledge to knowledge after the first exposure), a description of the nature of the revision, and the nature of the revision expressed more abstractly.

The girls' revised knowledge structures associated with the indicators of *get a complete picture* have been characterised in three ways. The revised knowledge structures were shown to be more *inclusive*, *elaborative* and *integrative*. In essence, the effect of *get a complete picture* was manifested as three effects in the revised knowledge structures. Inclusive and elaborative revised structures were structures where the girls showed more detailed and more comprehensive descriptions. The integrative structures were revised structures where the girls showed more holistic, integrated knowledge structures, often having first developed more inclusive and then integrated them into more holistic structures after a later exposure. Each of these three constructs are discussed below.

5.3.2.1 More inclusive knowledge structures

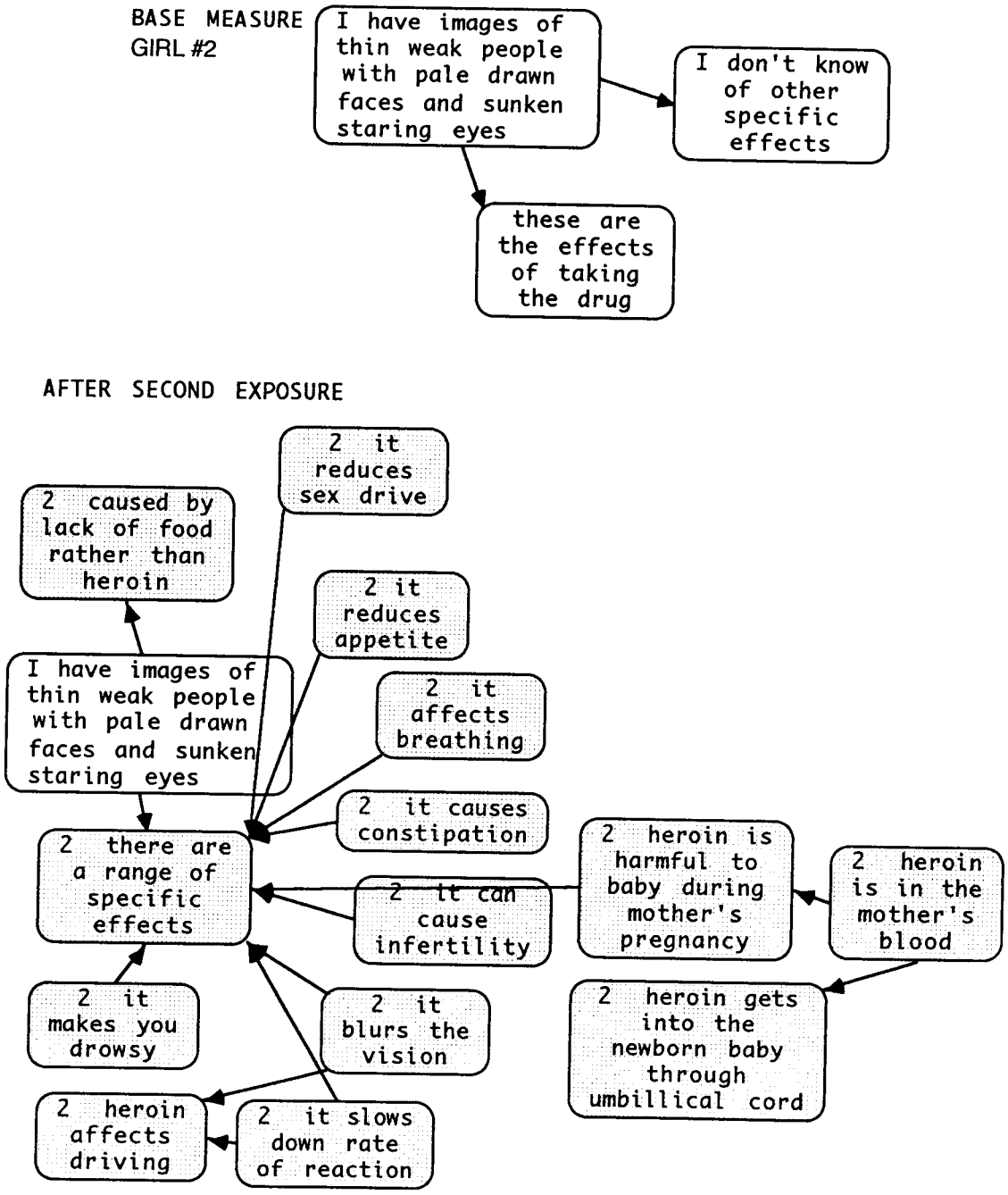
A more inclusive knowledge structure resulted when the girls added specific instances, examples or types to more general propositions . It was shown in the revised knowledge structures as new specific nodes being linked to more general nodes through the relation "is a". For example, Girl #2 indicated that "the new information gives me specific examples to work with, such as examples of the specific effects". In the examination of her knowledge structures related to the specific effects of heroin, she expanded the node "there are range of specific effects" by including nodes such as "it affects

breathing", "it can cause infertility" and "it reduces appetite". Implied in these added nodes was the "is a" relation - each added proposition is a specific effect. At a more abstract level, what was happening here was expanding a general class "effects of taking heroin" by stating what was specifically included in this class, such as "it reduces appetite". The initial knowledge structure was changed from a general structure to a structure that showed greater specificity and precision of ideas through building set membership.

When the girls utilised information to *get a complete picture*, the inclusive effects showed up in the revised knowledge structures in two ways. The distinction between these two ways is based on the starting point for the appending of new ideas to the structures.

The first type of inclusive knowledge structures was labelled Inclusive Knowledge Structure (Type 1). It occurred when the girls included set membership nodes to a more inclusive statement that already existed in their knowledge structures. In this change, the existing node specified the general class of entities that the added node(s) belonged to. An example of this is shown in Figure 23. This series of two conceptual graph structures shows the changes for Girl #2 in relation to the specific effects of taking heroin. This is based on the indicator "the new information gives me specific examples to work with, such as examples of the specific effects". The initial knowledge structure stated "effects of taking the drug" as "thin weak people with pale drawn faces and sunken staring eyes". After the second exposure to information, this initial knowledge structure was revised. The more inclusive concept of "specific effects" expressed in the node "there are a range of specific effects" was expanded by appending specific cases of the set of effects, such as "it reduces appetite" and "it affects breathing". Here the revised knowledge structure is made more inclusive through set membership.

FIGURE 23
INCLUSIVE KNOWLEDGE STRUCTURE: TYPE 1



The second type of inclusive knowledge structure, labelled as Inclusive Knowledge Structure (Type 2) was where the girls added a new node or a structure of nodes to an organising concept which was a nucleus around which a structure was built. The new node(s) represented a more particular representation of the more inclusive organising concept. For example, some of the girls organised their written responses around headings such as

"reasons why people take drugs". These headings were seen to represent an organising concept under which their existing knowledge was then articulated. These headings were often referred to in the indicators. For example, Girl #3 stated "I found out more reasons why people take heroin". Under this heading, Girl #3 identified and expanded on a number of specific reasons, such as "people who take drugs are not satisfied with their lives". After the exposure to information, Girl #3 was able to add new specific knowledge structures which presented other reasons, thereby expanding the organising concept.

Figure 24 shows an example of Inclusive knowledge structure (Type 2). This example is by Girl #1, based on the indicator "get a more complete picture: that's an expanded picture, you know more about an idea and what is related to it, for example the reasons why people take drugs". The base measure showed a small knowledge structure based around the reason "they take drugs to escape or forget their problems". This was linked to the heading "Reasons why individuals take the drug" provided by Girl #1. The revised knowledge structure after the first exposure showed the appending of a knowledge structure commencing with the node "status of the drug rather than heroin itself" which was appended to the organising concept. The first node in this structure represented a more specific reason; the structure belonged to the set of "reasons" and was part of the set membership of "reasons".

FIGURE 24
INCLUSIVE KNOWLEDGE STRUCTURE: TYPE 2

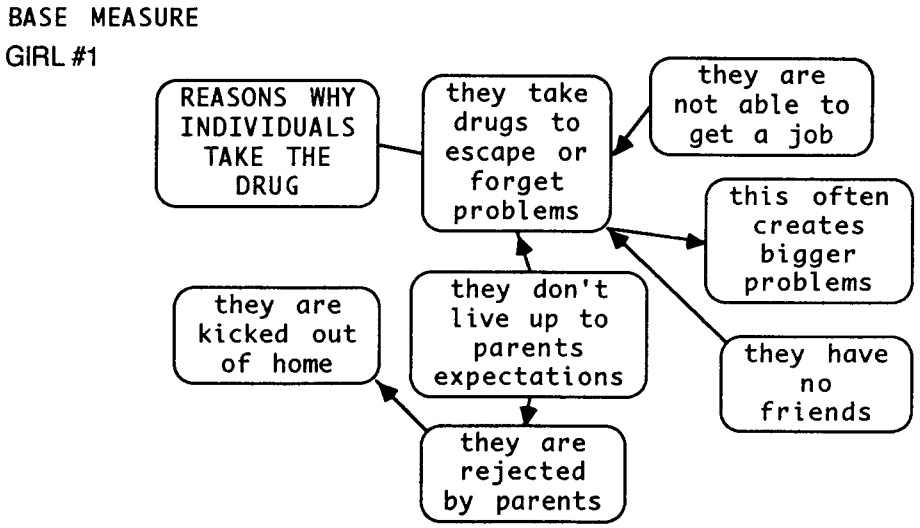
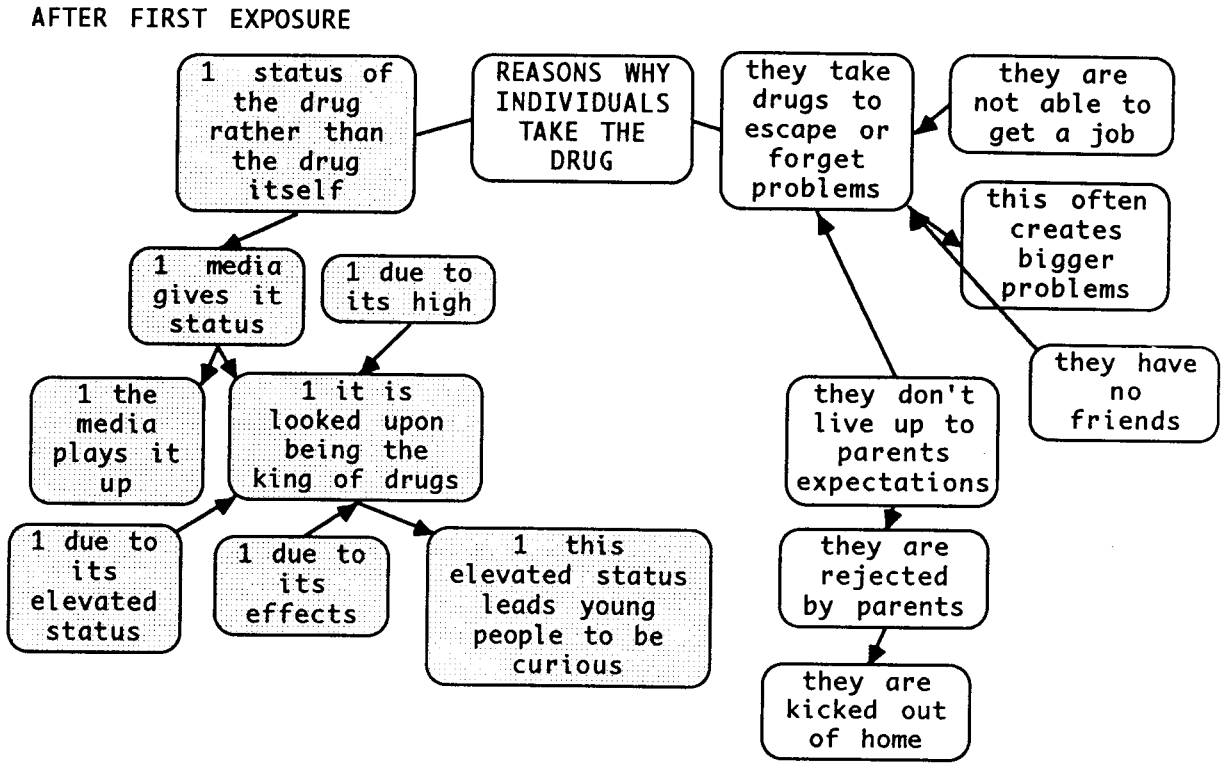


FIGURE 24 (continued)
INCLUSIVE KNOWLEDGE STRUCTURE: TYPE 2



5.3.2.2 More elaborative knowledge structures

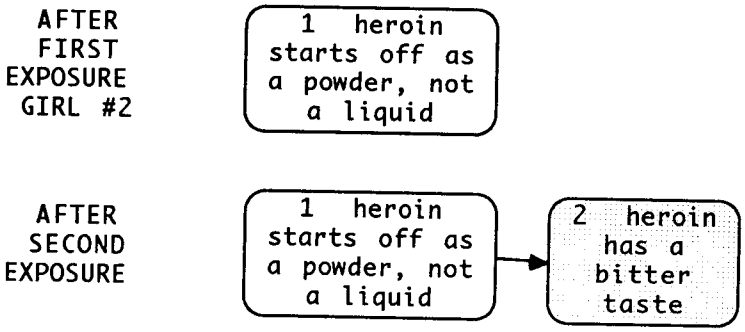
The second type of revised knowledge structures associated with *get a complete picture* were more elaborative knowledge structures. A more elaborative knowledge structure resulted when the girls utilised the information to expand existing nodes or organising concepts by defining them, and / or describing their characteristics, processes, styles and causes. More elaborative knowledge structures were different to more inclusive knowledge structures in terms of the nature of the relationship between the existing knowledge and the information that was subsequently included. More inclusive knowledge structures demonstrated hierarchical relationships; more elaborative knowledge structures contained associative relationships.

In some cases, the elaborative changes were quite simple, involving a few nodes in a linear sequence; in other cases, they were more complex, involving many interlinked nodes. Some of the conceptual graph structures shown in the following examples illustrate both the complexity of the resultant

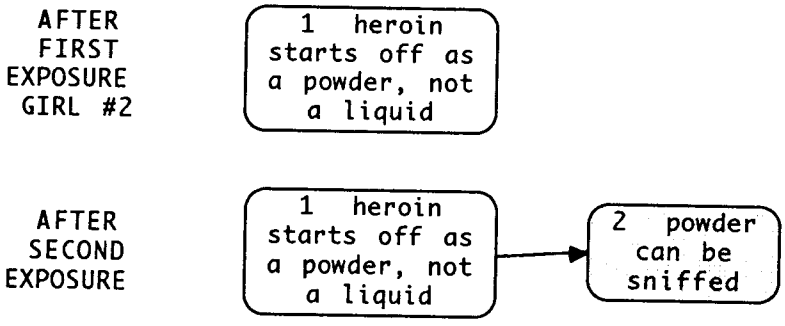
structures, as well as the girls' ability to integrate large amounts of information at any one time into their existing knowledge.

Four types of elaborative knowledge structures emerged out of this analysis. These four types of elaborative knowledge structures will be described with some simple examples, then some full examples of conceptual graph structures showing these will be presented and discussed:

1. *property-oriented structures*: These were revised structures in which the girls described static properties, features or attributes of previously existing knowledge. For example, a concept in a structure was often elaborated by its physical, social and / or internal attributes. The relations in these elaborations embodied "has" and "contains" and established aspects such as direction, quantity, size, weight, qualities and spatial relations, as shown in the following example:

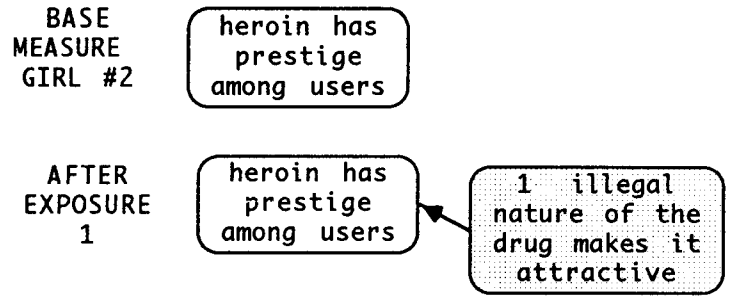


2. *manner-oriented structures*: These were structures where the girls denoted how an action occurred, and / or where they specified a process, or outlined a style. The structures generally specified the manner in which events occurred or states existed. For example:



3. *cause-oriented structures*: These were events chain structures where the girls outlined causally driven mechanisms and described

consequences. The relations in these structures tended to embody "results in", "enables", and "leads to". For example, Girl #2 initially states "heroin has prestige among users". Appended to this after the first exposure is a node that provides the cause: "illegal nature of drug makes it attractive".



4. *goal-oriented structures*: In these structures, the girls elaborated goals, reasons and outcomes. The structures showed events / states that people desired. The relations in these structures tended to be reason or initiate arcs. The outcomes and goal were expressed both positively or negatively. For example, the appended node in the following example identifies an outcome of the original node.

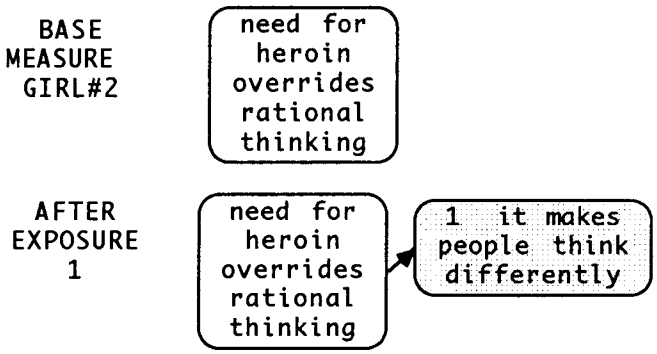
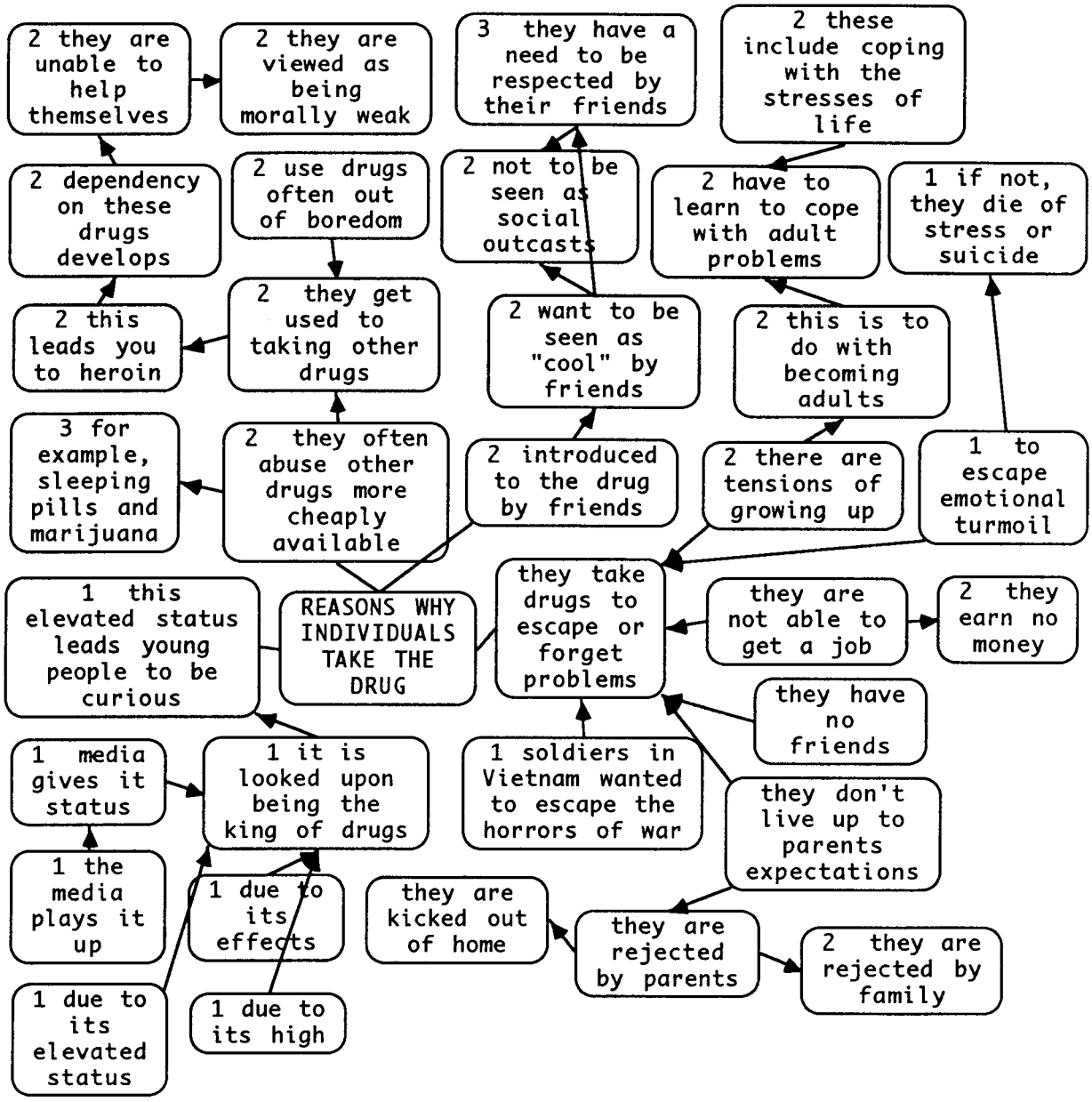


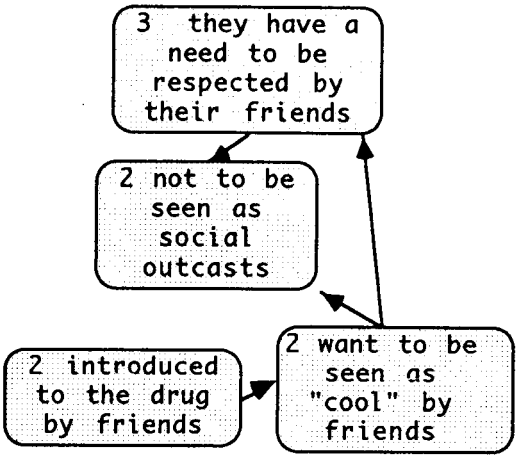
Figure 25 illustrates some of these types of elaborative structures for Girl #1. This conceptual graph structure was her knowledge after the third exposure of why individuals take heroin. This structure was identified in relation to the indicator "you get a more complete picture. That's an expanded picture: you know more about an idea and what is related to it, for example, the reasons why people take drugs. In the discussion of this example, Individual structures will be highlighted.

FIGURE 25
ELABORATIVE KNOWLEDGE STRUCTURES



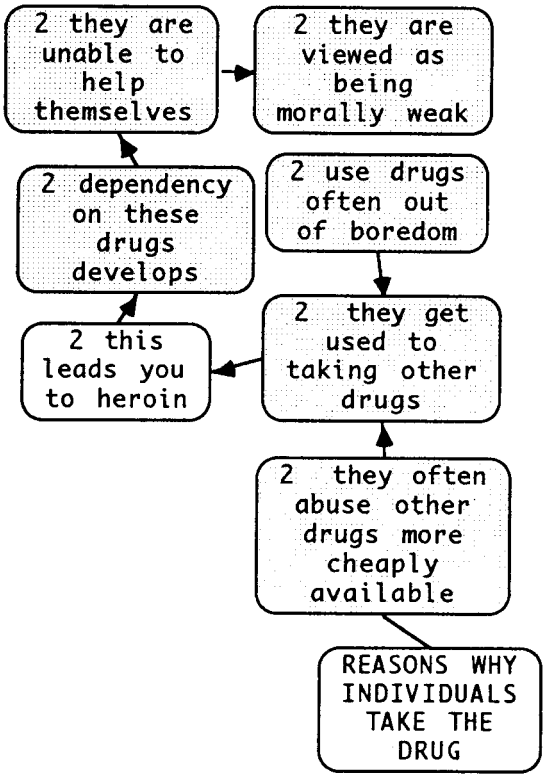
The substructure shown in Figure 26 commencing with the node "introduced to the drug by friends" and appended to the organising concept "Reasons why individuals take the drug" was a goal-oriented structure which established the goal "want to be seen as "cool" by friends" and outcome "not to be seen as social outcasts". It was appended to the organising concept after the second exposure. After the third exposure, the node "they have a need to be respected by their friends" was inserted between the nodes "want to be seen as "cool" by friends" and "not to be seen as social outcasts". The relations in this structure were reason arcs.

FIGURE 26
GOAL-ORIENTED KNOWLEDGE STRUCTURE



The substructure shown in Figure 27 commencing with the node "they often abuse other drugs more cheaply available" and appended to the organising concept "Reasons why individuals take the drug" was a chain of events that outlined cause-effect, representing a cause-oriented structure.

FIGURE 27
CAUSE-ORIENTED KNOWLEDGE STRUCTURE



The structure shown in Figure 25 also showed an example of an inclusive change, where the set of "drugs" was expanded with specific types "sleeping pills and marijuana". This is shown below in Figure 28. The example also showed that different types of elaborative changes were brought together in expanding the knowledge structure.

FIGURE 28
INCLUSIVE KNOWLEDGE STRUCTURE

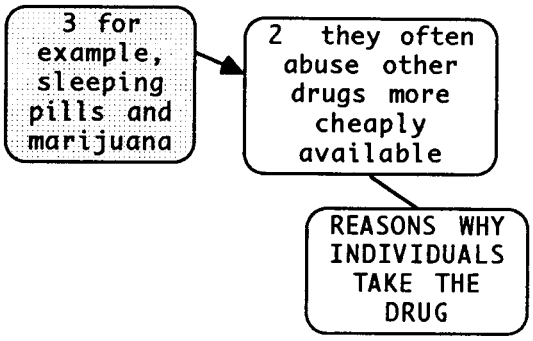


Figure 29 shows property-oriented and manner-oriented knowledge structures for Girl #1. It was based on the indicator "there was a lot of new information here; before I knew almost nothing about how heroin addicts are treated". Appended after the third exposure to the node "cold turkey is a form of treatment" were a number of nodes which provided property and style characteristics of "detoxification", such as "it is a three weeks process". Also appended was a goal-oriented structure based on the concept "success", such as "it is not successful if used alone".

FIGURE 29
PROPERTY AND MANNER-ORIENTED KNOWLEDGE STRUCTURES

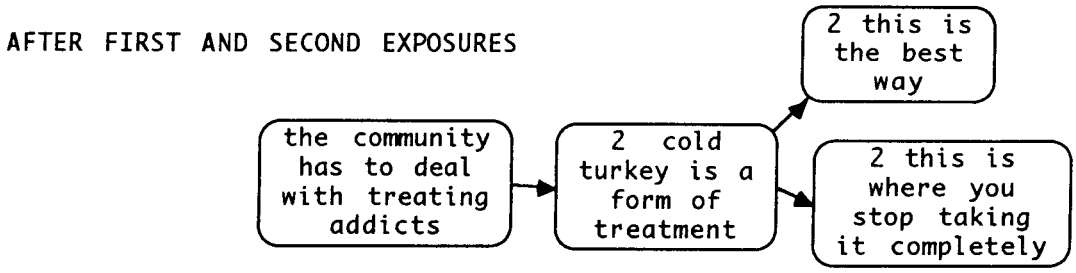
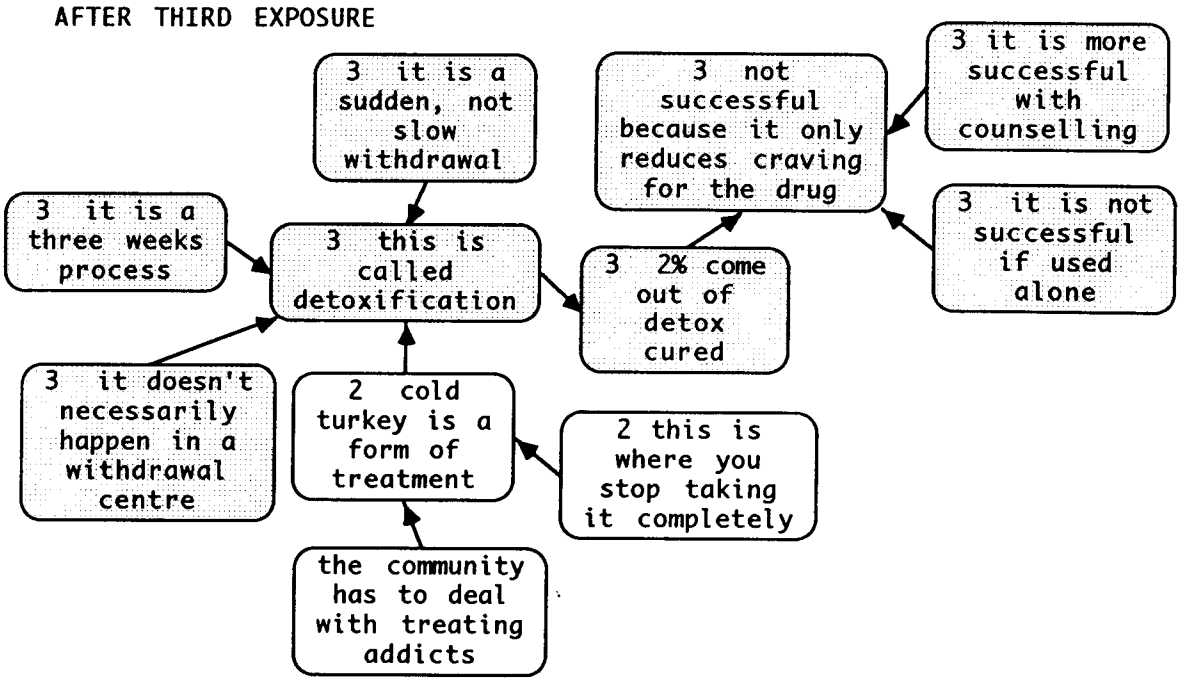


FIGURE 29 (continued)
PROPERTY AND MANNER-ORIENTED STRUCTURES



5.3.2.3 More integrative knowledge structures

In a small number of cases, some of the revised knowledge structures associated with *get a complete picture* showed more than hierarchically related detail or elaboration. Some separate structures that were expanded by elaborative or inclusive changes were later linked together by presenting ideas that brought together separate substructures. The outcome for the girls was both more expanded knowledge structures and more holistic, or integrated, knowledge structures. Figure 30 illustrates an integrative change for Girl #3. This change was associated with the indicator: "I learned that the added ingredients posed greater danger. I didn't know this".

FIGURE 30
INTEGRATIVE KNOWLEDGE STRUCTURE

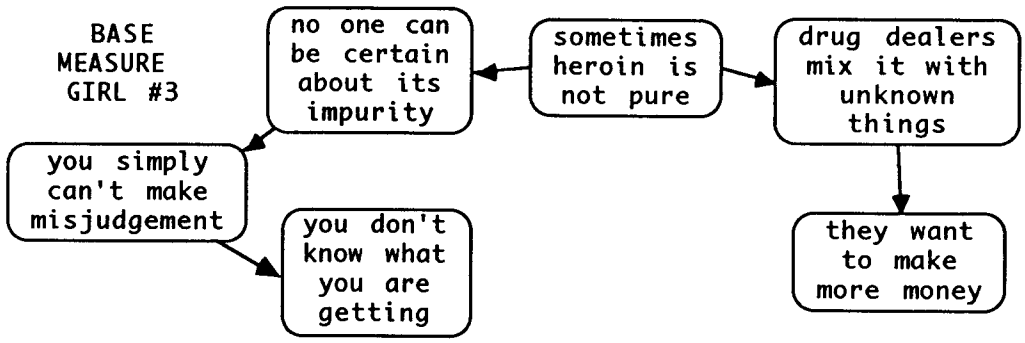
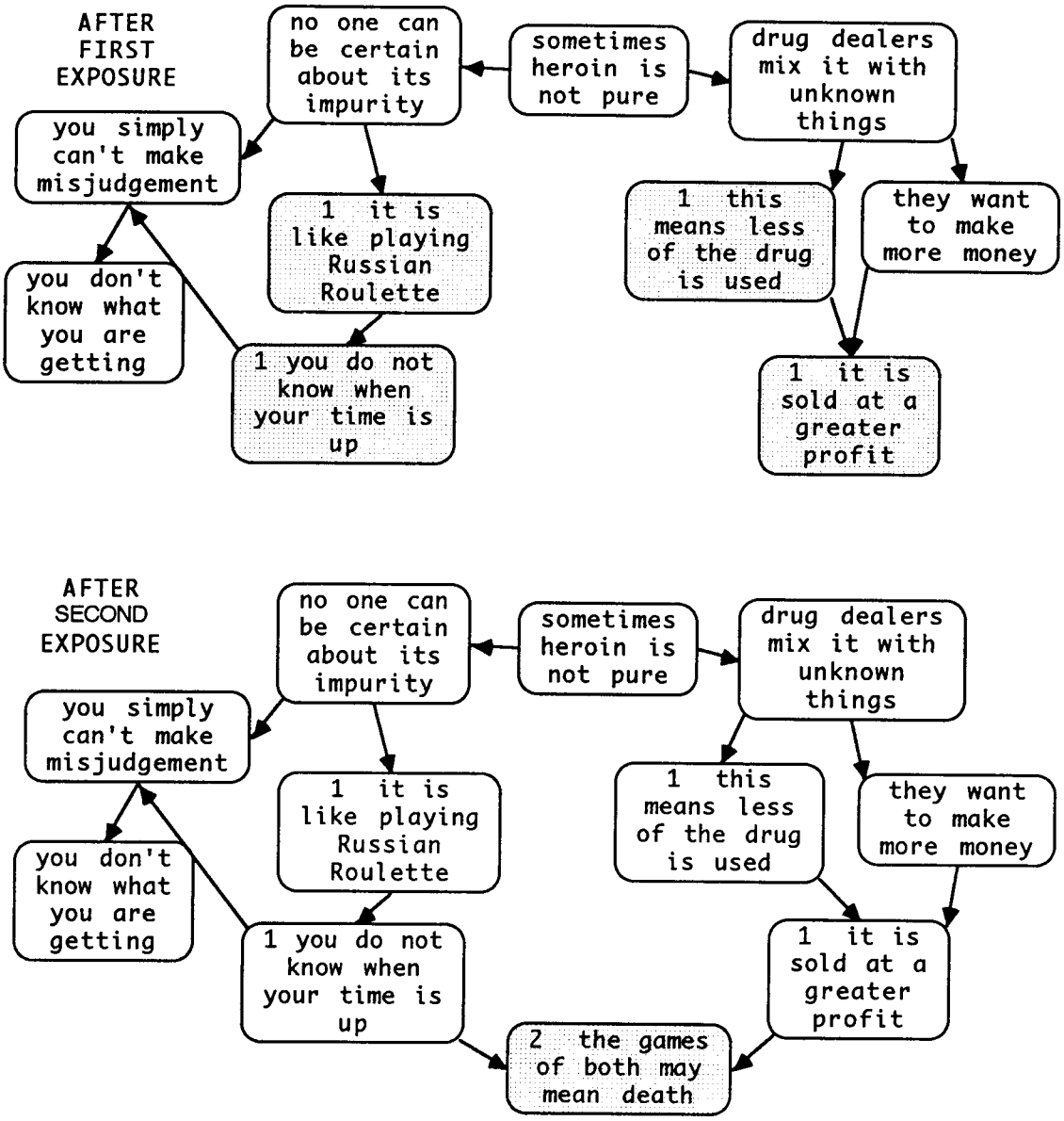


FIGURE 30 (continued)
INTEGRATIVE KNOWLEDGE STRUCTURE



In this example, the initial knowledge structure contained two sets of nodes based on the node "sometimes heroin is not pure". One set of nodes focused on the role of the drug dealer, while the other focused on the role of the heroin user. After the first exposure, these two sets of nodes were developed further as separate structures. In the user-centred structure, a set of nodes was inserted between the nodes "no one can be certain about its impurity" and "you simply can't make misjudgement" that explained why a misjudgement couldn't be made. In the drug dealer structure, a small goal-oriented structure was developed. After the second exposure that provided information on the

consequences of heroin use and addiction, these two separate structures were linked together by the node "the games of both may mean death". This node was the culmination of both structures, based on "results in" relations.

5.3.3 *Get a complete picture:* patterns

Tables 7 and 8 present the patterns found in the revised knowledge structures constructs related to the perceived effect *get a complete picture*. These tables have been derived from the analyses presented in Appendix 4, Table 5.

TABLE 7
NUMBER AND NATURE OF CHANGED KNOWLEDGE STRUCTURES
GET A COMPLETE PICTURE

GIRL #1

cognitive strategy	**revised knowledge structure**	**n**
appending	Inclusive Level 1	12
	Inclusive Level 2	5
	Elaborative	16
	Integrative	2
inserting	Elaborative	1
	Integrative	1

GIRL #2

cognitive strategy	**revised knowledge structure**	**n**
appending	Inclusive Level 1	5
	Inclusive Level 2	2
	Elaborative	10
	Integrative	2
inserting	Elaborative	1
	Integrative	1

GIRL #3

cognitive strategy	**revised knowledge structure**	**n**
appending	Inclusive Level 1	5
	Inclusive Level 2	2
	Elaborative	9
	Integrative	2
inserting	Elaborative	2
	Integrative	2

TABLE 7 (continued)
NUMBER AND NATURE OF CHANGED KNOWLEDGE STRUCTURES
GET A COMPLETE PICTURE

GIRL #4

cognitive strategy	**revised knowledge structure**	**n**
appending	Inclusive Level 1	4
	Inclusive Level 2	3
	Elaborative	8
	Integrative	2
inserting	Elaborative	4
	Integrative	1

TABLE 8
NUMBER AND NATURE OF CHANGE SEQUENCES
GET A COMPLETE PICTURE

GIRL #1

cognitive strategy	**change sequence**	**n**
appending	Inclusive Level 1 -> Elaborative	6
	Inclusive Level 2 -> Elaborative	4
	Inclusive Level 2 -> Integrative	1
	Elaborative -> Integrative	1
inserting	Elaborative -> Integrative	3

GIRL #2

cognitive strategy	**change sequence**	**n**
appending	Inclusive Level 1 -> Elaborative	4
	Inclusive Level 2 -> Elaborative	1
	Inclusive Level 2 -> Elaborative -> Integrative	1
	Elaborative -> Integrative	1
Inserting	Elaborative -> Integrative	2

GIRL #3

cognitive strategy	**change sequence**	**n**
appending	Inclusive Level 1 -> Elaborative	3
	Inclusive Level 2 -> Elaborative	1
	Inclusive Level 2 -> Elaborative -> Integrative	1
inserting	Elaborative -> Integrative	2

TABLE 8 (continued)
NUMBER AND NATURE OF CHANGE SEQUENCES
GET A COMPLETE PICTURE

GIRL #4

cognitive strategy	**change sequence**	**n**
appending	Inclusive Level 1 -> Elaborative	4
	Inclusive Level 2 -> Elaborative	2
	Inclusive Level 2 -> Elaborative -> Integrative	1
Inserting	Elaborative -> Integrative	4

These tables show that there were some patterns evident among the girls:

1. For all girls, the primary change to the knowledge structure in order to *get a complete picture* was made through appending. While insertings were also employed, appendings substantially outnumbered insertings.

2. For all girls, the changes of structure through appending could be characterised chiefly as elaborative and inclusive, with a small number of integrative changes. For all girls, elaborative knowledge structures were the most common type of revised knowledge structure, followed by, in order of frequency, Inclusive (Level 1); Inclusive (Level 2), and Integrative .

3. For all girls, the changes of structure through inserting were all elaborative and integrative changes. These appeared to occur equally amongst girls.

4. For all girls, there was a sequence of change activity in order to *get a complete picture*. Some changes brought about by appending and inserting did not work in isolation. When the initial changes through appending were inclusive changes, these often led to elaborative changes, and in a small number of cases to integrative changes. These occurred at the time of exposure and after other exposures; where the initial changes were elaborative changes, these often led to integrative changes. Elaborative changes through inserting in most cases also led to integrative changes.

5.4 GET A CHANGED PICTURE

5.4.1 Description of *get a changed picture*

As shown in Table 3 (p. 179), the girls identified that utilising information in the exposures enabled them to *get a changed picture*. Table 9 shows the number of times the girls mentioned indicators of this effect in relation to each exposure. All the girls showed that they utilised the information in the information exposures in order to *get a changed picture*, and did this to a similar extent. There was only a little variation in the total number of indicators provided by each girl. There does not appear to be any notable differences between the girls in the number of indicators provided for this effect. For Girls #1, #3 and #4, the second exposure provided the most indicators of getting a changed picture, and the third exposure provided the least number of indicators.

TABLE 9
NUMBER OF INDICATORS: GET A CHANGED PICTURE

STAGE	GIRL 1 *n*	GIRL 2 *n*	GIRL 3 *n*	GIRL 4 *n*	Total *n*
DEBRIEFING	3	2	1	1	7
EXPOSURE 1	1	1	2	2	6
EXPOSURE 2	2	4	3	2	11
EXPOSURE 3	1	0	2	1	4
TOTAL	7	7	8	6	28

n = number of indicators of *get a changed picture* provided in written and verbal responses recorded after each exposure, and in the debriefing session

The construct *get a changed picture* was derived from 28 indicators that were identified as conceptually similar through the constant comparison approach as documented in Chapter 4.3. The complete list of indicators is provided in Table 23 in Appendix 5. Collectively these indicators suggested that the girls utilised information in the exposures to make changes to their existing ideas. "Change" was a term often mentioned by the girls. For example, in the debriefing session, they made general comments like: "I've changed my mind many times - new facts that show some of my facts were wrong"; and "I found some of my ideas were wrong, so I changed them"; and "I changed some of my ideas". Change was also implied in some other statements from the debriefing session, such as: "it corrects what is wrong, you thought something before and it isn't right" and "you can get your facts right".

While it could be said that any difference between an initial knowledge structure and a knowledge structure after exposure to information was a "changed" picture, (indeed Brookes referred to changed knowledge structures) the girls viewed "change" more specifically, linking it to differences in specific facts and perspectives previously stated. This came out clearly in their comments in the written and verbal responses, where they linked the notion of change to specific facts. Some typical comments that they made were: "This is a change. Heroin starts off as a powder, not as a liquid first"; "I've said before that it affects all of the organs of the body, that's not so, it is in fact less harmful than alcohol. I've fixed that up"; "I was wrong before when I said that addicts are treated in hospital" and "I said before that morphine is extracted from heroin. I've changed my mind".

Some of the indicators provided by the girls also established the reasons for getting a changed picture. For example: "some of the effects I mentioned like heroin causing violence before are wrong; this is opposite to what I said before"; "I thought before that addiction happens after the first try. Now I know that this isn't so. It takes time"; "I always thought before that heroin was a relatively new drug. That was wrong. Heroin originated long before Christ"; "correction - I had previously thought that heroin was extremely harmful to one's health. Since reading the information I've changed my mind"; "the detail and accuracy of the information helped change my ideas, such as how the linking of taking drugs with prostitution isn't true". "Changed" in this context was where the information exposures enabled the girls to determine that existing ideas were incorrect or inappropriate, enabling them to reject the initial idea and remove it from the picture. Some matching of existing ideas against the information appeared to take place.

The indicators also showed that in some instances, removing an incorrect idea was accompanied by replacing it with a new, correct idea. The replacement idea(s) were often a modification of the removed idea, that is, one of the concepts in the idea was maintained, while the other was removed and replaced with a new predicate and argument(s). In some other instances, the whole proposition was replaced with a completely new idea.

While *get a changed picture* was primarily seen in relation to correcting specific facts, the girls also provided some evidence of a wider notion of getting a change in perspective rather than just a change in facts. For

example, Girl #3 commented that "the baby image isn't a good one, this is wrong, given what I've read about the calming effects". In this instance, she was commenting about a set of statements which compared the process of treatment to that of removing a pacifier from a baby. The image of a screaming baby, in the light of the information, was not considered to be "a good one", and was subsequently deleted. Girl #3 also commented that "the information has changed my perception of the drug, especially knowing that alcohol is just as dangerous". Rather than correcting specific facts, the change here indicated that the exposure to information enabled her to change her perception of the drug.

5.4.2 Manifestation of *get a changed picture* in changes to the girls' knowledge structures

This section of the results presents the associations between what the girls said about the effect *get a changed picture* and the changes, or not, to their knowledge structures related to that effect. As with the other indicators of effects, the associations have been derived from the analytical and comparative procedures documented in Chapter 4.4.

Table 10 shows the number and type of cognitive strategies for *get a changed picture* for each girl.

TABLE 10
NUMBER AND TYPE OF COGNITIVE STRATEGIES:
GET A CHANGED PICTURE

COGNITIVE STRATEGIES	GIRL 1 *n*	GIRL 2 *n*	GIRL 3 *n*	GIRL 4 *n*	Total *n*
appending	16	10	11	13	50
deleting	6	6	5	4	21
inserting	1	1	0	1	3
Total	23	17	16	18	74

n = the number of indicators of cognitive strategies identified

Where each indicator was associated with a knowledge structure, a number of cognitive strategies were often identified in a subsequent revision. In order to *get a changed picture*, the girls appended and deleted information, and to a lesser extent, inserted information into their existing knowledge. This pattern appears to be consistent between all of the girls. There were 50 instances of appending, 20 instances of deleting, and 3 instances of inserting identified in

their conceptual graph structures associated with the effect. Table 24 in Appendix 5 provides a full summary of the documentation associated with this analysis that formed the basis of establishing the nature of the revised knowledge structures. This summary identifies each specific indicator, the level where a change was indicated in the knowledge structure, the cognitive strategy, and a brief description of the nature of the revision to the knowledge structure.

In the analysis of the changes to knowledge structures associated with the specific indicators of the effect, what was clearly apparent, and as shown in the summary information, was that appending, inserting and deleting did not work as isolated strategies, that is, appending and inserting did not by themselves establish the effect of *get a changed picture* as defined. Rather, in many cases they were a prelude to deleting, which was the primary cognitive strategy. In essence, it was evident that *get a changed picture* for the girls was often a multistage process. Utilising information here to bring on the perceived effect seemed to be an active, comparative process of moving between existing knowledge and the information in the exposures, setting up the knowledge requirements, and acting on these. Rather than describing the revised knowledge structures as discrete and separate entities, the existing knowledge went through stages of revision, conceptualised as "construction", "deconstruction" and "reconstruction". These changes worked together to build the changed picture, as the girls appeared to define it.

At this point, a comment needs to be made in relation to temporal order. The order of whether appending, deleting or inserting came first was derived from the order of presentation of the ideas of the particular topic linked to a specific indicator in the written and verbal responses, and traced over the different exposures. For example, Girl #2 identified the following change: "correction - I had previously though that heroin was extremely harmful to one's health. Since reading the information, I've changed my mind". This indicator *established a content area related to the harmful effects of heroin on health.* The existing knowledge structure related to this content area was mapped, as were subsequent knowledge structures after each exposure related to this content. In most cases, an order could be established. In some cases, appending took place in one part of the revised knowledge structure, while in another part of the same knowledge structure, deleting was evident. It is difficult to establish which came first here, and while the linear order of the

transcripts provided some clue, it is also acknowledged that the order may be dependent on grammar and logical construction, rather than cognitive change order.

The stages of *get a changed picture* will now be described. Following this description, a number of cases are presented and discussed.

5.4.2.1 Revised knowledge structures: construction stage

In order to *get a changed picture*, the girls first appeared to utilise the information to build up a more detailed, descriptive picture. This process of construction was primarily through appending. The most common types of revised knowledge structures at this stage were inclusive and elaborative structures, similar conceptually to those documented in the analysis of *get a complete picture*. This construction appeared to impact in two ways. Emerging out of the more detailed and elaborated picture was a recognition that ideas or concepts in the existing knowledge structure were problematic. Some cognitive matching of existing propositions in the knowledge structure and new propositions appeared to take place, the appended structures in effect becoming both the arena where the contradictory propositions were detected, and the evidential base for establishing that in fact they were contradictory.

The outcome of this constructive stage was sometimes the acknowledgment that some propositions were "wrong" or "not correct" or "opposite". For example: "the reason I've had for the images is not correct"; "I was wrong when I said that addicts are treated in hospital" and "I had always associated using heroin with violence. This is not correct". In a number of indicators the girls appeared to verify that their existing ideas were wrong, for example: "I originally thought that it has the worst effects of all drugs" and "I had thought previously that treatment was done through media campaigns. Wrong again!" Often the girls restated the incorrect idea as a negative proposition in their declarative knowledge. For example, Girl #2 spoke about heroin having severe and harmful effects on the body. She said "heroin affects the nervous system", followed by "you become violent". After the second exposure which presented information on the effects of taking heroin, a changed node was presented "it causes non-violent feelings", and the node about violence was

replaced with the negatively stated node "people are non-violent when they are on heroin".

In a small number of cases for each girl, the information did not appear to first bring on a constructive change of building a complete picture; rather, there was an up-front acknowledgment that a proposition was incorrect, and it was deleted. In these cases, getting a changed picture commenced with deleting, rather than appending. For example, in the conversation with Girl #2, she stated that "I always thought before that heroin was a relatively new drug. That was wrong. Heroin originated long before Christ". Her initial knowledge structure about the history of the drug consisted of one node "heroin is a modern drug". Her revised knowledge structure showed that this node had been deleted, and a new starting node "heroin originated long before Christ" was in place.

5.4.2.2 Revised knowledge structures: deconstruction stage

The second phase of *get a changed picture* that the girls seemed to go through was a change conceptualised as "deconstruction". Here, the problematic concept(s) or idea(s) were removed by deleting. (This happened in all but one instance, discussed later and shown in Figure 35.) The girls seemed to delete ideas in two ways. The first was by removing a complete proposition, where the argument(s) and predicate making up the proposition were found to be incorrect, and so it was totally removed. For example Girl #4 said "I always thought heroin was a recent modern discovery. I didn't realise it goes back a long time". Her initial knowledge of heroin consisted of one node "heroin is a modern drug of young people today". In the following knowledge structure this was deleted and replaced with a new starting node "heroin is prominent in history".

In some cases, more than one node was deleted. This was where nodes attached to the incorrect node were more inclusive nodes of that incorrect node, that is, they provided set membership details. For example, Girl #1 initially stated that one of the effects of heroin was: "there might be change of personality". Attached to this node were two more inclusive nodes of set membership that elaborated types of change to personality: "they might become schizophrenic" and "they might become retarded". In establishing that the more inclusive node was incorrect, and deleting it, it appeared to be

that the more inclusive nodes were also considered incorrect as they were also deleted.

A more common type of deleting undertaken by the girls was the removal and subsequent replacement of a component of a proposition, resulting in a new proposition that was a modification of the existing one. For example, Girl #1 initially stated "morphine is extracted from heroin". This was changed to "1898, heroin isolated as an active ingredient of morphine." In the replaced proposition, in addition to the inclusion of the date, the arguments "morphine" and "heroin" were retained though their order of presentation was inverted, and the predicate was changed, thereby establishing a new correct relationship between heroin and morphine. In another case, Girl #1 removed the statement "there might be a change of personality" and replaced it with "it delays the maturing of the personality". In this example, she appeared to recognise that heroin had an effect on personality. The unstated concept of "effect" was retained, but the level of the effect was modified from "a change of" to "delays the maturing of".

Generally the propositions that were deleted were seen as erroneous facts. The information in the exposure appeared to establish that these facts were wrong. For example, Girl #3 deleted "the people are treated in hospital", and replaced it with "there is a threefold system of treatment in Australia." However, in two cases, the deleted nodes were position statements, which changed in the course of the exposure to information. For example, as shown in Figure 31, Girl #1 initially stated that "cold turkey" as a form of treatment "is the best way". Given the absence in her knowledge structure of related or supporting ideas, this position statement appears to have been based on limited factual evidence. As a result of the exposure, a set of ideas around "detoxification" was appended which provided facts about the process of treatment and success rates, and brought about a change of position to "I don't think it is the best way".

In one instance discussed later and shown in Figure 35, getting a changed picture was not brought about by deleting-appending; or appending-deleting-appending sequence common to most changes in structure associated with the effect. In our conversations, Girl #4 stated: "this is a change. Heroin starts off as a powder, not as a liquid first". The indicator suggested that she had changed her idea about the originating nature of heroin. Her knowledge

structure showed that two nodes were later appended to the node "heroin comes in liquid form". The appending shifted the position of the node from that of a starting node to that of a conclusion. The original node was retained. The outcome was to give a changed understanding of the nature of heroin.

5.4.2.3 Revised knowledge structures: reconstruction stage

After deleting, there was evidence that the girls utilised the information to rebuild and / or further extend their pictures. This rebuilding or extending was conceptualised as "reconstruction" and was almost always brought about by appending, with a few instances of inserting. Once an incorrect node had been deleted, it was often replaced by another node in the same position as the deleted node. This replaced node, derived from the information exposures, was the starting point for substantial appendings that extended the knowledge structure, resulting in other effects, such as *get a complete picture* and *get a position in a picture*. While these changes might be more appropriately viewed as *get a complete picture*, for the instances cited, these effects contributed to what girls perceived as *get a changed picture*. In some cases, the removal of a node left a sequence of nodes "hanging". These nodes, still valid despite the deletion, were repositioned, through appending, to other nodes in the structure.

Three cases are now discussed to illustrate the various stages identified above. The example shown in Figure 31 is by Girl #1. It is part of her knowledge structure about the implications of heroin use for the community, and focused specifically on treatment of heroin addiction.

FIGURE 31
GET A CHANGED PICTURE

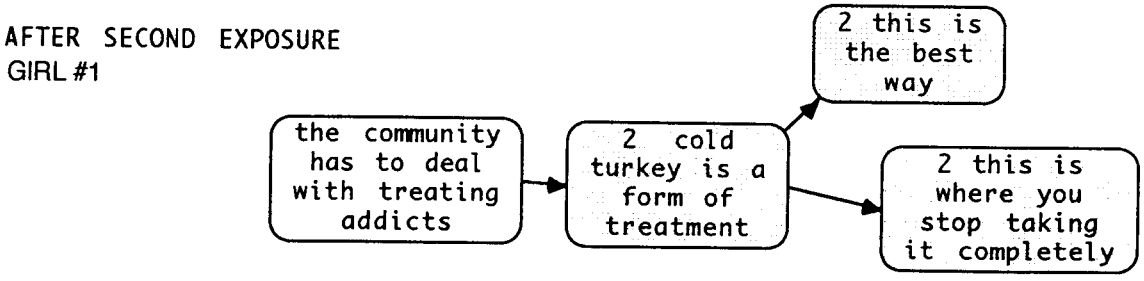
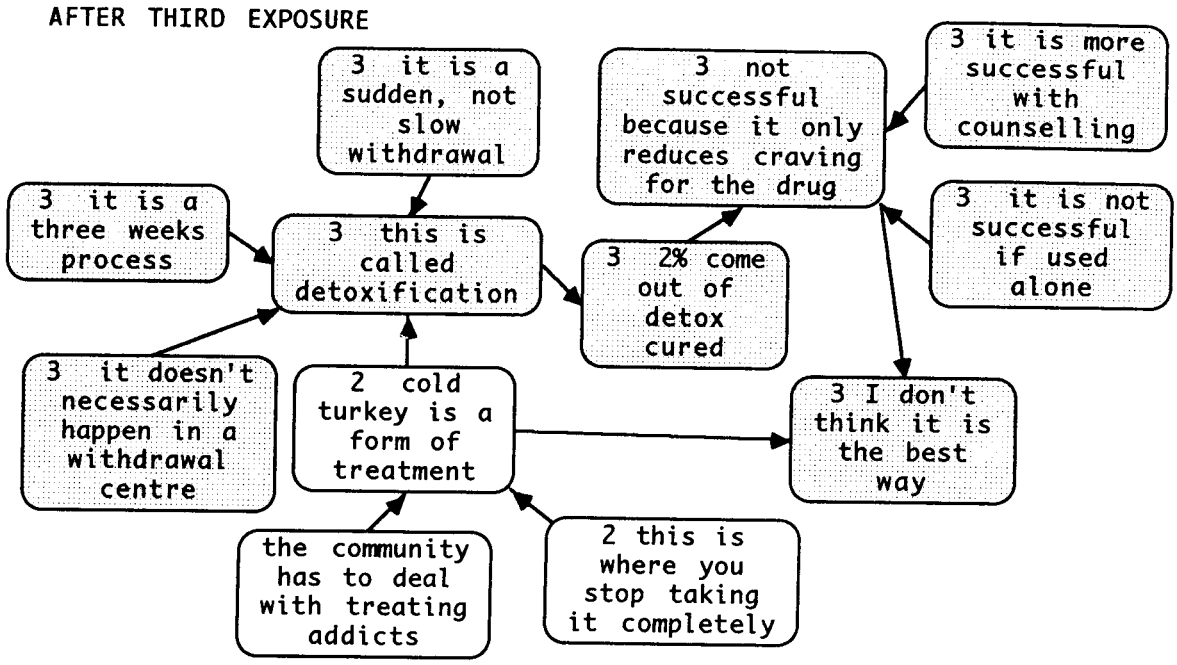


FIGURE 31 (continued)
GET A CHANGED PICTURE



In Figure 31, the perceived effect was stated by Girl #1 as "I've changed my view in terms of it [detox] being the best way". The comparative analysis of the structures suggested that the perceived effect had been derived from three changes to structure which moved through the change process of construction -> deconstruction -> reconstruction. These are shown in the following steps:

1. appending to existing node "the community has to deal with treating addicts". The appending elaborated set membership of treatment by identifying and defining "cold turkey" as a form of treatment. A position statement based on these facts was also appended: "this is the best way".

2. appending of nodes to the node: "cold turkey is a form of treatment". These elaborated specific type: standard nomenclature, specific aspects of process; facts on conditions of success; statistical data on success. These built up an expanded picture of detoxification.

3. on the basis of these facts, the node "this is the best way" was removed. The appended facts appeared to contribute to a reassessment of the previously stated position.

4. the node "I don't think this is the best way" was appended in place of the deleted node.

The example in Figure 32 is from Girl #2 and was part of her knowledge about the nature and incidence of heroin, and focused on perceptions of the origins of heroin. The indicator of the effect was "I always thought before that heroin was a relatively new drug. That was wrong. Heroin originated long before Christ". She identified that the information enabled her to correct the wrong idea. The initial knowledge structure related to the origin of heroin was limited to one node "heroin is a modern drug". The structural changes evident were deconstruction -> construction. The stages were:

1. the exposure to information, which documents the history of the drug, enabled the judgement to be made that the starting node was wrong, and it was subsequently deleted. A new starting node "heroin originated long before Christ" replaced this deleted node.

2. with this new node was appended an acknowledgment that the original knowledge was changed "I thought heroin was a modern thing from western countries", in essence, verifying the replaced node.

3. the effect of this change was then being able to append a complex structure of 64 nodes related to the historical origins of heroin. (A portion of this appended structure is shown)

FIGURE 32
GET A CHANGED PICTURE

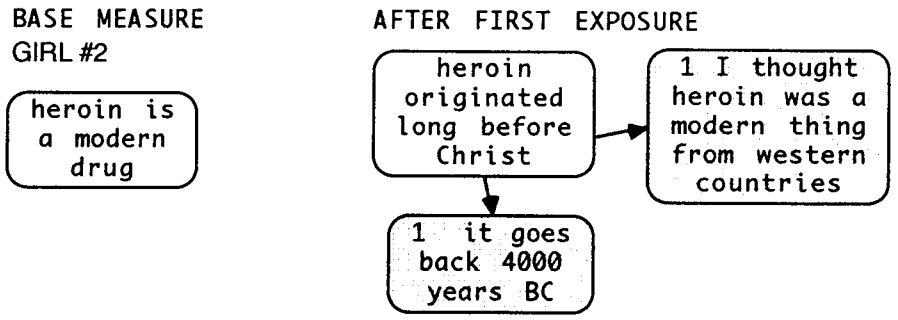
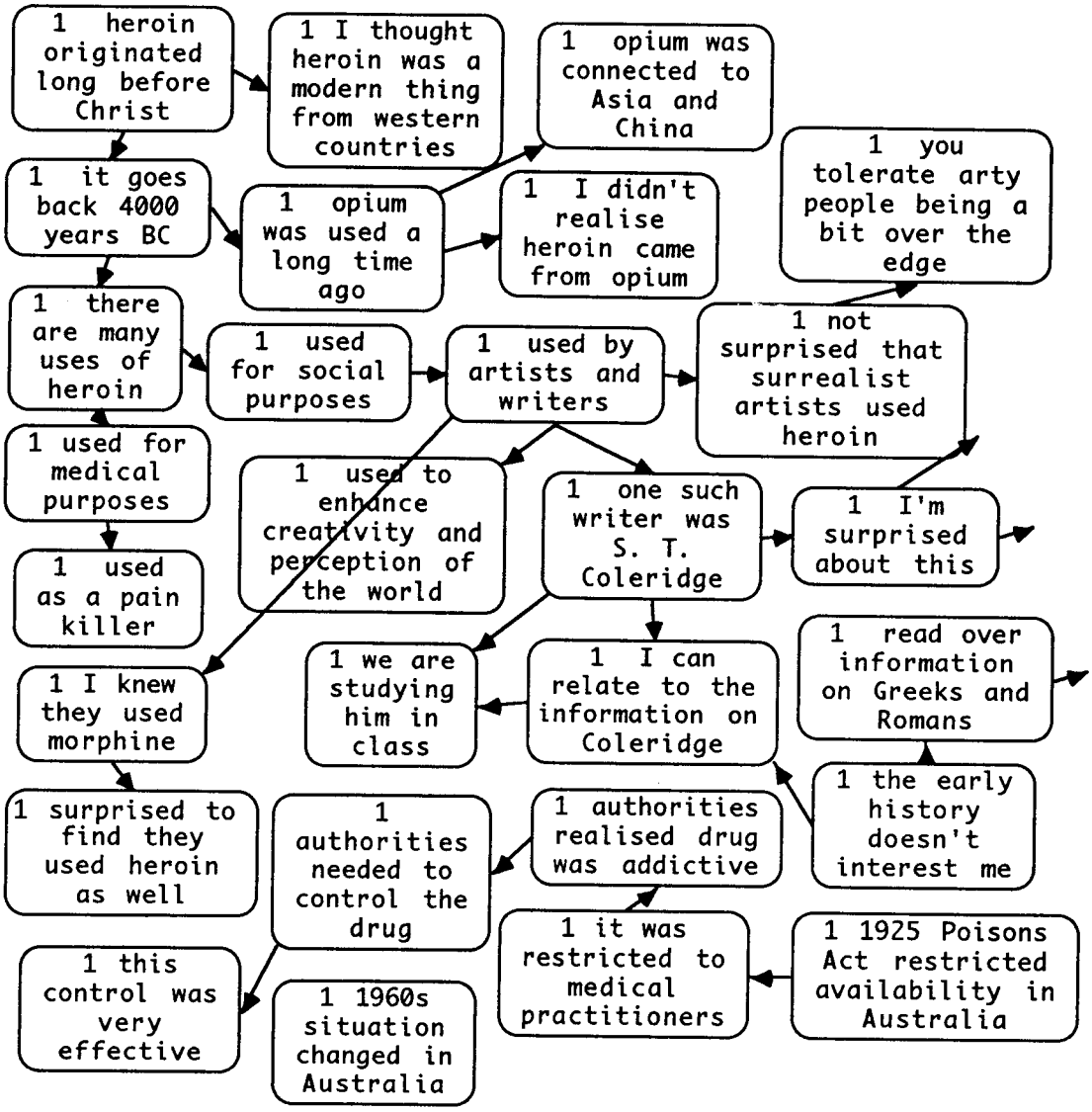


FIGURE 32 (continued)
GET A CHANGED PICTURE

AFTER FIRST EXPOSURE

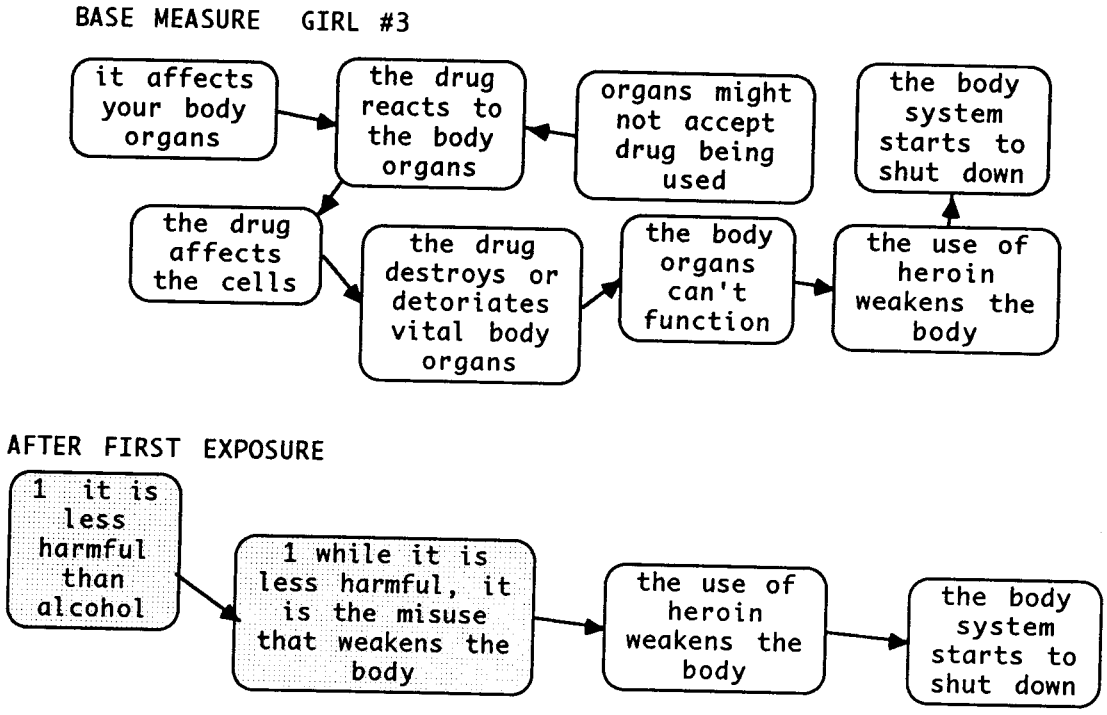


The example in Figure 33 was by Girl #3 and linked to the indicator: "I've said before that it affects all of the organs of the body. That's not so, it is in fact less harmful than alcohol. I've fixed that up". In this instance, she was able to utilise the information to identify and correct an idea that was incorrect. In order for her to establish the perceived impact, the following changes took place:

1. the exposure to information established the fact that "it [heroin] is less harmful than alcohol". This appeared to conflict with the initial node "it affects your body organs", and she acknowledged that this node "is not

so", that is, it is not correct. As a consequence, the node "it affects your body organs" was deleted. However, the structure after the first exposure showed that an additional five nodes were also deleted. In acknowledging that heroin was less harmful than alcohol, the five nodes appended to the original node, which were a description of the process of how the drug affects the body, were also deleted.

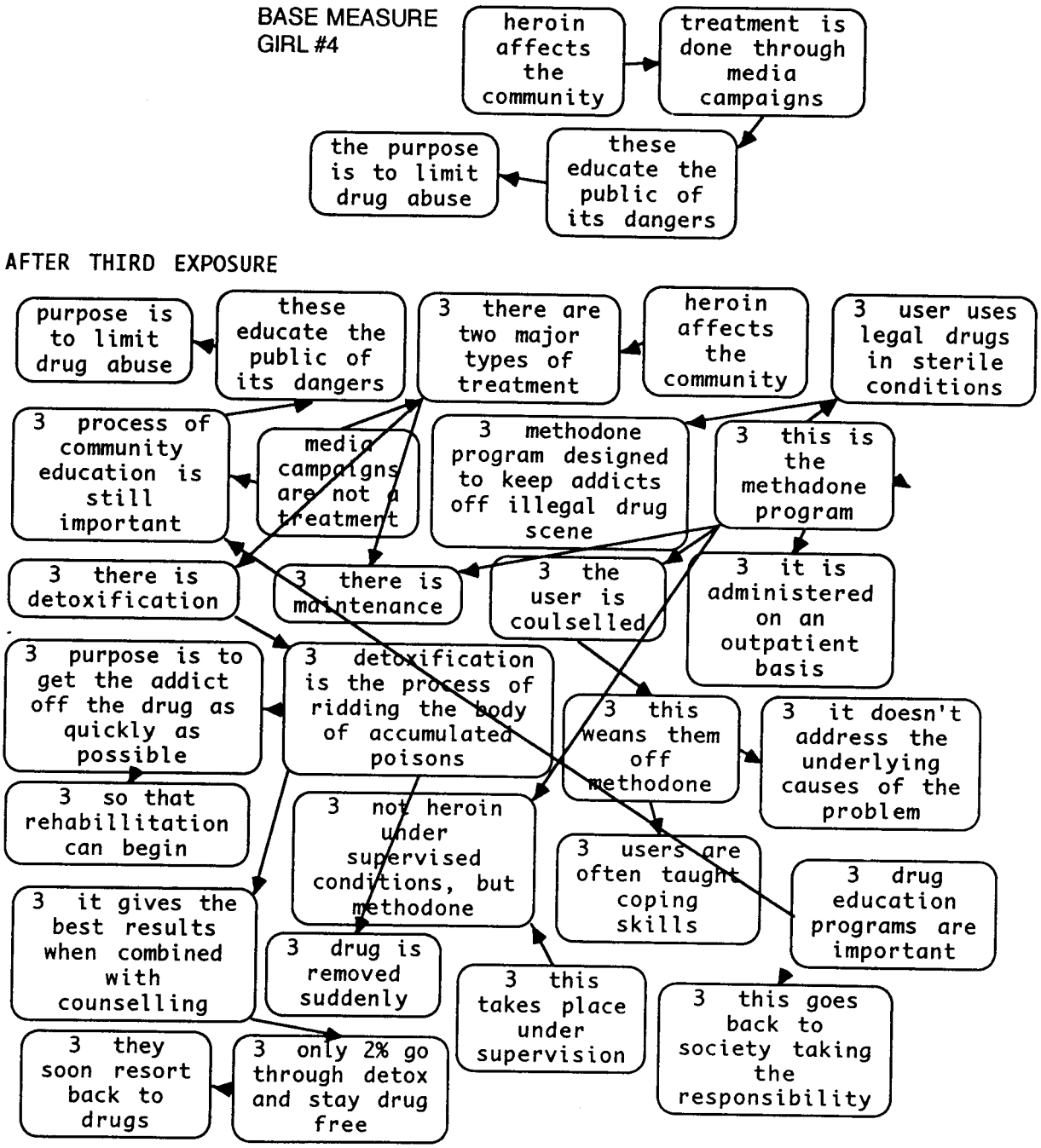
FIGURE 33
GET A CHANGED PICTURE



2. appended to the new starting node "it is less harmful than alcohol" was the node "while it is less harmful, it is the misuse that weakens the body". The conjunction "while" implies opposition or contrast, and this highlighted the incorrectness of the initial node. The conjunction "while" also enabled the acceptance of the conclusion of the original sequence, expressed in two nodes "the use of heroin weakens the body" and the consequence node "the body system starts to shut down". This was done through the statement "it is the misuse that weakens the body". The original conclusion, left hanging after the deletion, was repositioned by being appended to this node.

The example in Figure 34 was by Girl #4, and was based on the indicator: "I had thought previously that treatment was done through media campaigns. Wrong again!" She indicated that the information enabled her to identify incorrect facts. The content was about treatment.

FIGURE 34
GET A CHANGED PICTURE



A number of changes to her knowledge structure appeared to have been associated with the perceived impact:

1. the node: "treatment is done through media campaigns" was deleted. A new node "media campaigns are not a treatment" was appended that seems to verify the deleted node as incorrect.

2. a new node "there are two major types of treatment" was appended. This was an inclusive node that appeared to be the starting point for organising the facts provided in the exposures.

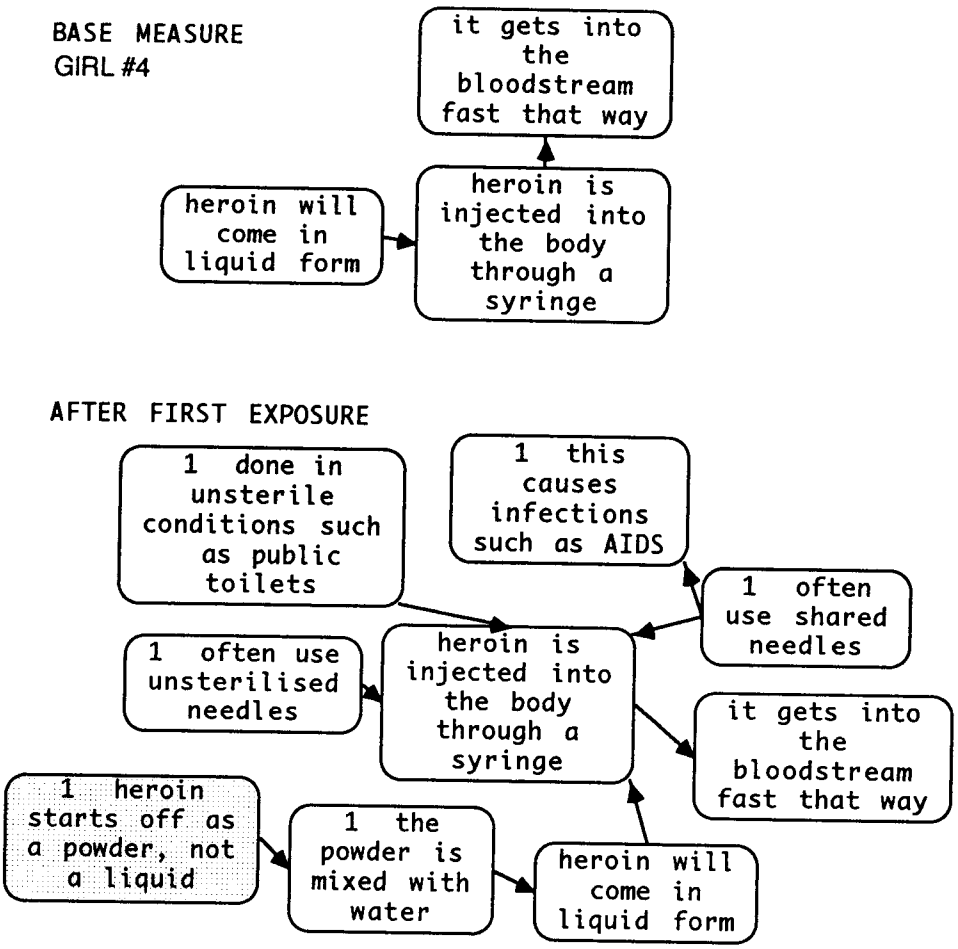
3. the appending to these organising nodes of a set of facts about each of the two types of treatment, "there is maintenance" and "there is detoxification". These were elaborative changes and resulted in getting a complete picture.

4. the inserting of a position statement regarding the value of drug education programs: "drug education programs are important". This inserting linked together the two separate substructures of facts about the forms of treatment (detoxification and maintenance).

5. this position statement enabled the appending of the conclusion: "process of community education is still important". The linking of this conclusion to an initial proposition: "these educate the public of its dangers" confirmed that the girl understood the purpose of dealing with the problem.

The example in Figure 34, referred to earlier, shows an unusual instance of *get a changed picture* by appending. Girl #4 said: "This is a change. Heroin starts off as a powder, not as a liquid first". The indicator suggested a change of idea on the origins of heroin. In her conceptual graph structure on the nature of heroin, two nodes were appended to the node "heroin will come in liquid form". The position of this node shifted from that of a "starting" position to that of a conclusion. The original node was retained.

FIGURE 35
GET A CHANGED PICTURE



5.4.3 *Get a changed picture:* some patterns

Overall for the girls, the following patterns were evident:

1. For two girls, the primary pattern for *get a changed picture* was appending -> deleting -> appending, with changed structures characterised as construction -> deconstruction -> reconstruction. The secondary pattern was deleting -> appending, which changed structures characterised as deconstruction -> reconstruction.

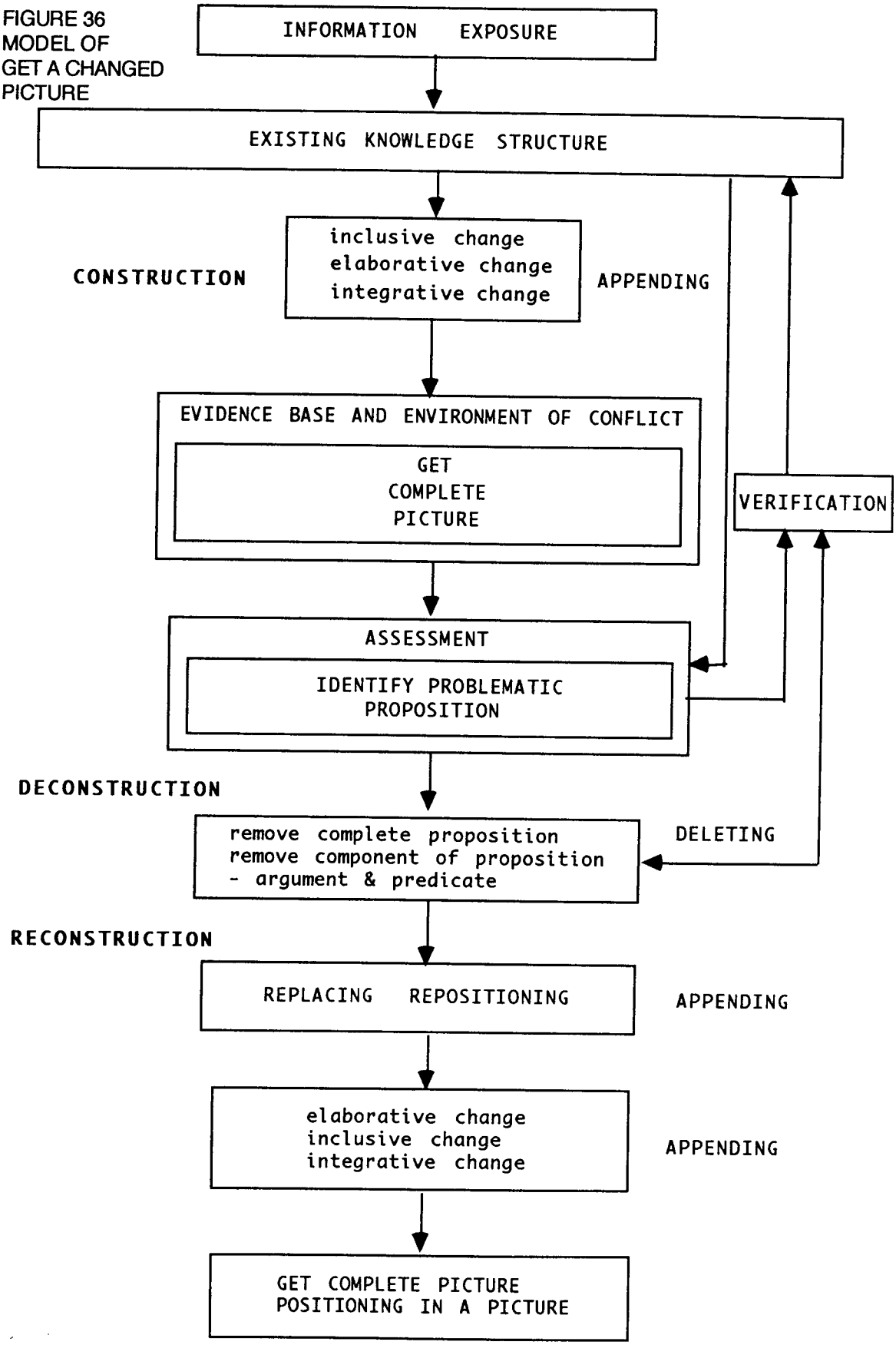
2. For the other two girls, the primary pattern was deleting -> appending, with changed structures characterised as deconstruction -> reconstruction. The secondary pattern for getting a changed picture was

appending -> deleting -> appending, with changed structures characterised as construction -> deconstruction -> reconstruction.

In summary, the above analysis showed that the girls utilised the information in the exposures *to get a changed picture*. They utilised information to correct inaccuracies in their existing pictures, and this was an active and constructive process of gathering evidence to build up a complete picture, making assessments of their picture, removing incorrect ideas, and replacing them in a reconstructive process with what they perceived to be more appropriate ideas.

In order to show more conceptually how the effect *get a complete picture* was associated with changes in the girls' knowledge structures, the model shown in Figure 36 is tentatively posited to illustrate the interrelationship of both the nature of the changes to the girls' knowledge structures and the cognitive strategies involved and to highlight the patterns identified. Many of the girls' instances of *get a changed picture* reflect all the components of the model; in some instances, the starting points and end points varied.

FIGURE 36
MODEL OF
GET A CHANGED
PICTURE



5.5 GET A CLEARER PICTURE

5.5.1 Description of *get a clearer picture*

As shown in Table 11, all the girls utilised the information to *get a clearer picture*. 24 indicators of this effect were evident in the data. This was a particularly predominant effect for Girl #4 who provided at least as twice as many indicators (12) of this effect than the other girls. Girl #2 provided only two indicators. The first and second exposures related to the origins and nature of heroin provided the most indicators and the third exposure provided the least number of indicators. Given the small numbers however, it is emphasised that the patterns are indicative of trends only.

TABLE 11
NUMBER OF INDICATORS: GET A CLEARER PICTURE

STAGES	GIRL 1 *n*	GIRL 2 *n*	GIRL 3 *n*	GIRL 4 *n*	Total *n*
DEBRIEFING	1	1	2	2	6
EXPOSURE 1	2	1	5	0	8
EXPOSURE 2	2	0	4	1	7
EXPOSURE 3	1	0	1	1	3
TOTAL	6	2	12	4	24

n = number of indicators of *get a clearer picture* provided in written and verbal responses recorded after each exposure, and in the debriefing session.

The effect *get a clearer picture* has been derived from these indicators. In the debriefing session, the girls made comments such as: "it explains things"; "it helps to clarify things I didn't understand before"; "I could sort out my fuzzy ideas"; "it gives you background information that helps clarify the picture"; and it "gives more reasons for something; makes a stronger argument; it explains". In these indicators, the girls appeared to suggest that the information enabled them to see their existing ideas and how these ideas were related together, with greater understanding and clarity. The information shed more light on their ideas so that the ideas could be seen more clearly. The girls cited a number of specific examples in the written and verbal responses: "it clarified some of the general statements I've made, like how methadone reduces addiction. It explains things"; "I understand more clearly now how the media influences people to take drugs" and "I understand the impurity problem a lot more clearly now". Such statements tended to be followed by a sequence of ideas which provided the details of clarification and explanation. In some

cases, the girls said that the exposures to information enabled them to sort out, organise and sequence their ideas more meaningfully; in other instances the information enabled them to resolve confusions and indistinctions, thereby providing clarification. For example: "I realise that I was confused before when I got all the effects mixed up. I could group my ideas better. It made sense" and "however, I realised that in my mind that the high cost had been confused with the cost of crack and cocaine". A full listing of the indicators of this effect is found in Table 25 in Appendix 5. In essence, *get a clearer picture* was all about discernment and understanding: getting illumination, clarification, explanation, and dealing with confusions and lack of clarity.

5.5.2 Manifestation of *get a clearer picture* in changes to the girls' knowledge structures

This section of the results presents the associations between what the girls said about the effect *get a clearer picture* and the changes, or not, to their knowledge structures related to that effect. As with the other indicators of effects, the associations have been derived from the analytical and comparative procedures documented in Chapter 4.4.

In order to *get a clearer picture*, the girls inserted and appended nodes into their existing knowledge structures. Table 12 shows the number and type of cognitive strategies for this effect.

TABLE 12
NUMBER AND TYPE OF COGNITIVE STRATEGIES:
GET A CLEARER PICTURE

COGNITIVE STRATEGIES	GIRL 1 *n*	GIRL 2 *n*	GIRL 3 *n*	GIRL 4 *n*	Total *n*
inserting	4	1	7	3	15
appending	5	0	4	3	12
Total	9	1	11	6	27

n=the number of instances of cognitive strategies identified

Overall for these girls, inserting was the predominant cognitive strategy which was associated with *get a clearer picture*, although there was no clear pattern. In order to describe more conceptually how this effect was associated with changes to the girls' knowledge structures, the knowledge structures associated with the specific indicators were analysed. Table 26 in Appendix

5 provides a summary of the documentation associated with this analysis that formed the basis of establishing the nature of the revised knowledge structures. This summary identifies each specific indicator, the level where a change was indicated in the knowledge structure, the cognitive strategy, and a brief description of the nature of the revision to the knowledge structure.

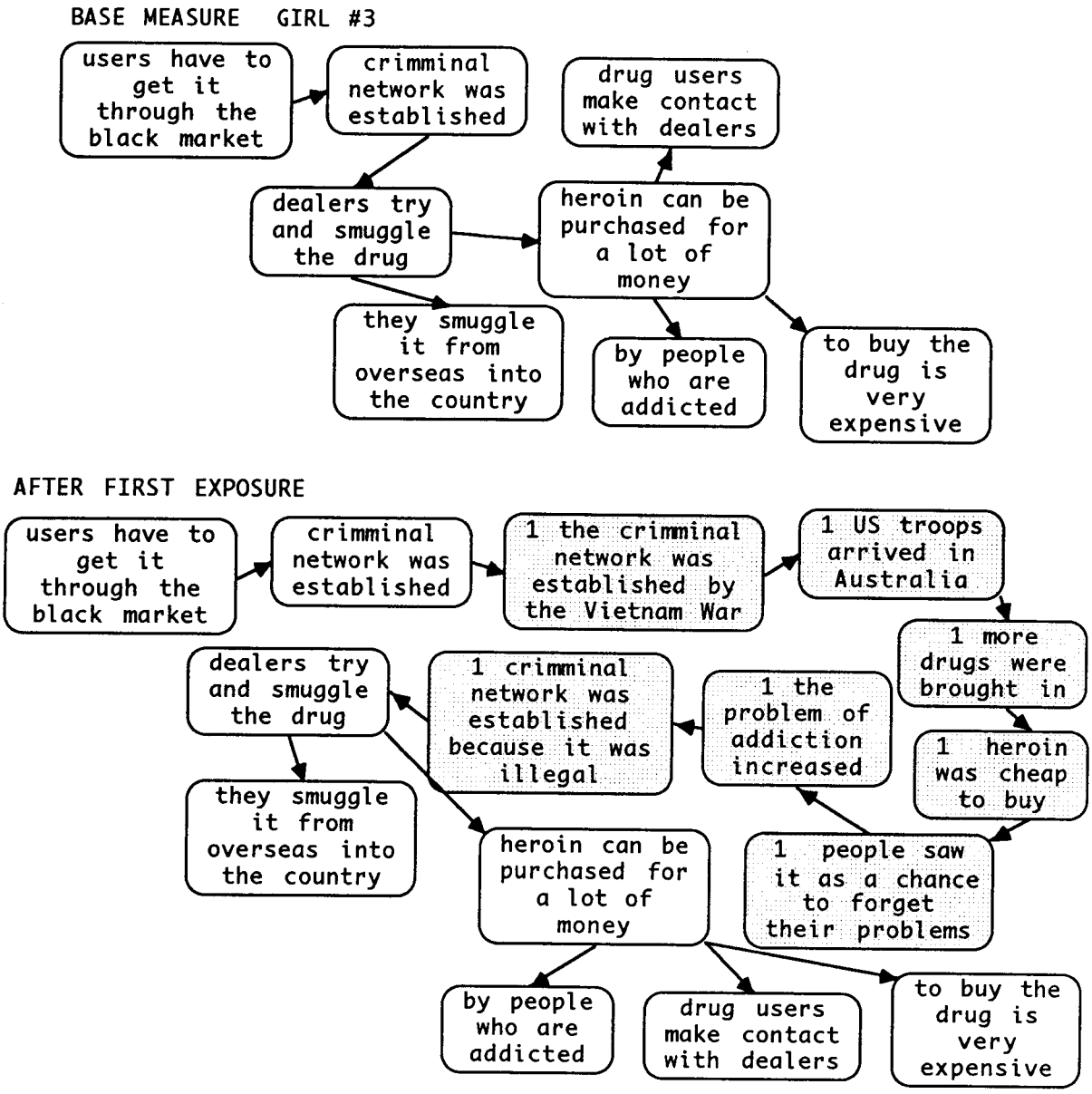
The revised knowledge structures identified in this analysis have been conceptualised in terms of explanation and precision.

5.5.2.1 Revised knowledge structures: explanation and precision

When the knowledge structures associated with the indicators were analysed, there was a clear pattern in the changes. The girls consistently inserted nodes in order to tell "how" or "why" their ideas were related. These nodes were explanatory in purpose. They added greater clarification and understanding to the girls' ideas by providing explanation. "How" explanations resulted in cause-oriented nodes being inserted. These nodes tended to present a linear sequence of intermediate events or states linked by "results in", "enables" or "leads to". "Why" explanations resulted in goal-oriented nodes being inserted. These sequences showed desired states or events, and reasons for them.

Figure 37 illustrates these changes. The example is from Girl #3, and was part of her knowledge structure on the nature and origin of heroin, and focused on the development of the criminal drug smuggling network in Australia. The indicator for *getting a clearer picture* was "it clarifies an idea. For example, explaining why the criminal network in Australia grew". Associated with this effect, the analysis of her knowledge structures showed that after the first exposure she inserted a sequence of nodes to provide an explanation of how, why, and when the criminal network was established in Australia. This insertion took place between the nodes "criminal network was established" and "dealers try and smuggle the drug".

FIGURE 37
GET A CLEARER PICTURE



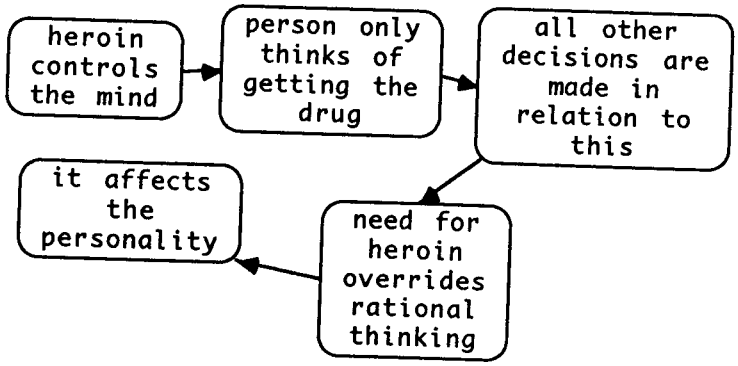
The sequence in the revised knowledge structure presented nodes related to the background of the criminal network, and the girl's argument for it. Some factual evidence for the initial proposition was provided, and she established "dealers try and smuggle the drug" as the conclusion to her argument.

The example shown in Figure 38 shows a part of Girl #2's knowledge structure about the implications of heroin use for the community. It was the initial knowledge structure associated with the indicator "I understand more clearly how heroin takes over your thinking". The revised knowledge structure showed the inserting of a sequence of nodes between the nodes

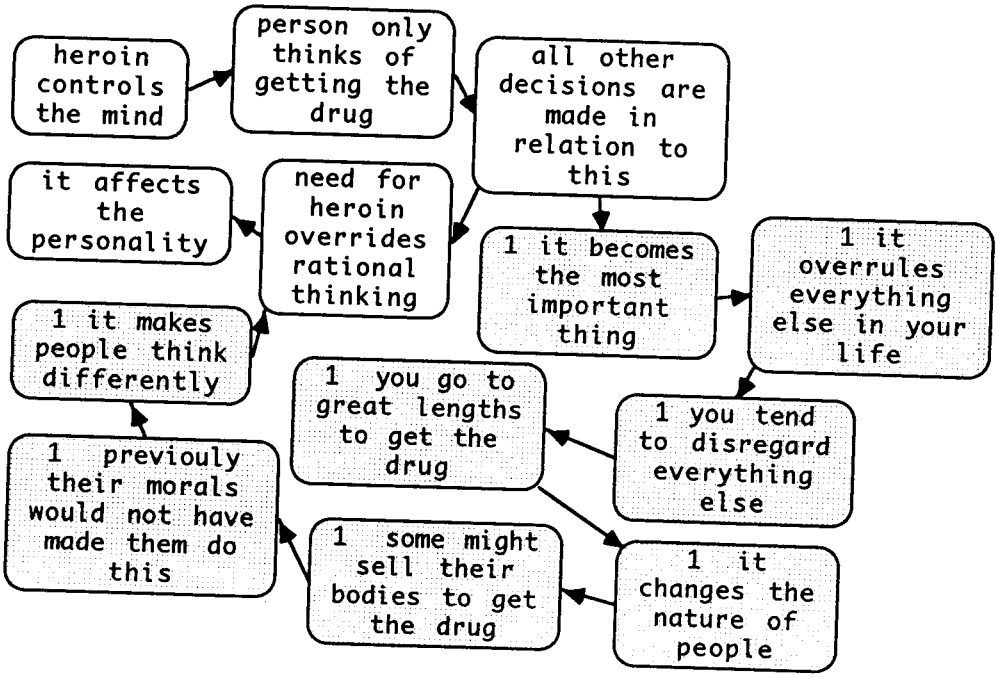
"all other decisions are made in relation to this" and "need for heroin overrides rational thinking".

FIGURE 38
GET A CLEARER PICTURE

BASE MEASURE
GIRL #2



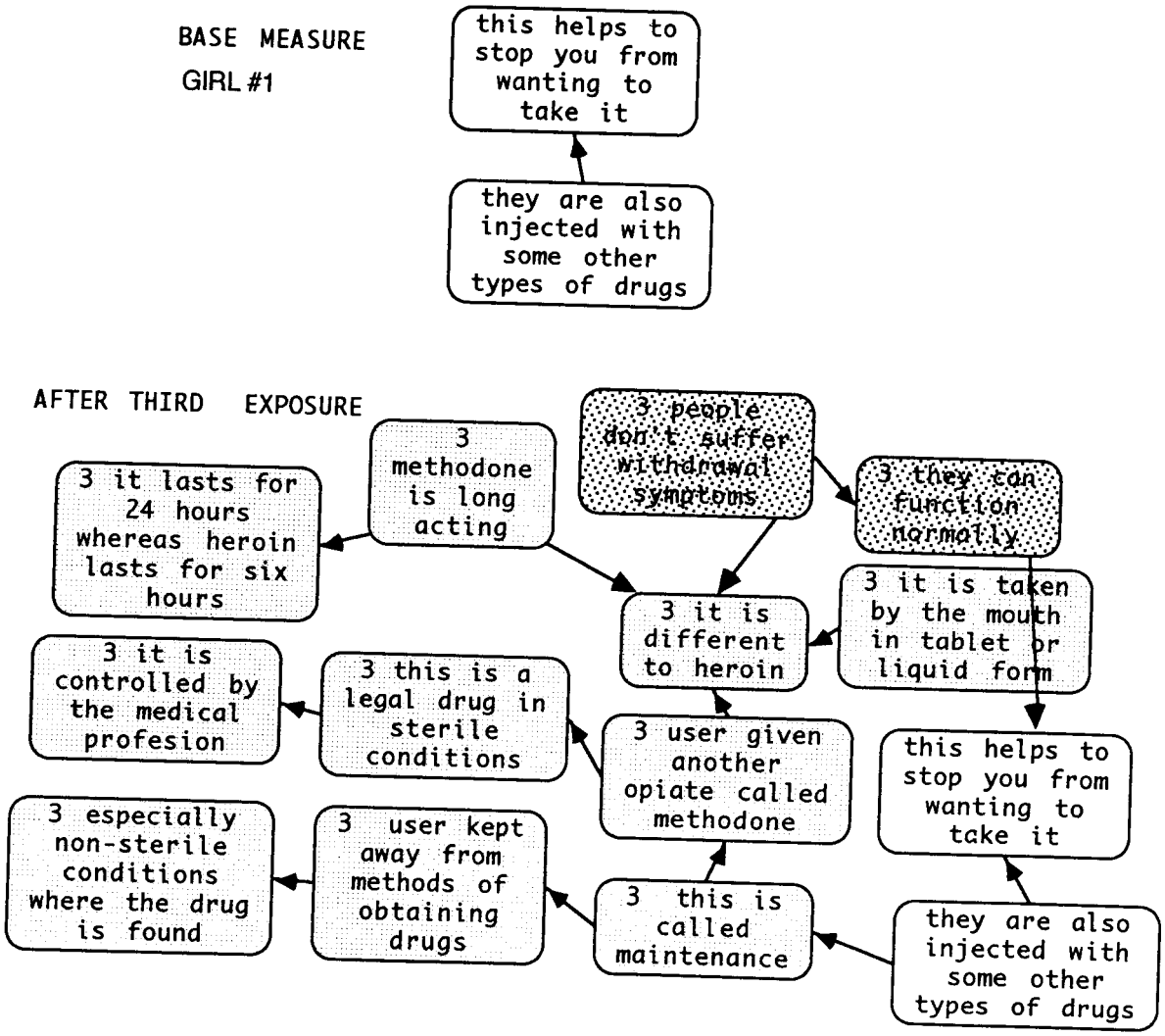
AFTER FIRST EXPOSURE



The inserted sequence provided an explanation of how the decision making process in relation to the drug overrides irrational thinking. The argument outlined the intermediate stages, and clarified the relationship initially established. It appeared to give the relationship greater certainty and strength. The presentation of this argument in a sequence of nodes is how the effect was manifested in this knowledge structure.

The example in Figure 39 shows part of Girl #1's knowledge structure about approaches to treatment of heroin addiction. This part focused on maintenance as a form of treatment. In discussing the effects of the exposures to information, she said "it clarified some of the general statements I've made, like how methadone reduces addiction. It explains things". The initial knowledge structure had two nodes identifying how treatment takes place, and the outcome.

FIGURE 39
GET A CLEARER PICTURE



Associated with the indicator of *get a clearer picture* here are two changes to the initial knowledge structure. Appended to the node "they are also injected with some other type of drugs" was a set of nodes (lighter shading) that gave an expanded picture of how heroin addicts were treated. They added factual detail about nomenclature, definition and characteristics of "maintenance" as

a form of treatment; provided specifics of the process of maintenance; and provided comparison of the impact of heroin versus methadone. This appending was then the basis for the second change in structure, that of inserting. The inserting (darker shading) took place between the nodes "it is different to heroin" and "this helps to stop you from wanting to take it". These nodes provided an explanation as to how methadone "helps".

In order to get *a clearer picture*, appendings were primarily used to include precision of detail and to elaborate nodes, as shown in Figure 38. *Get a clearer picture* was associated with knowledge structures that showed precision and specificity of ideas through building up set membership details or specific property / attribute details. Consequently, their appended substructures tended to be set membership or property substructures. The question that arises here is how does this differ from *get a complete picture?* The difference is one of context. While these revised knowledge structures should technically be classified as inclusive and elaborative structures associated with *get a complete picture*, in the context of their development the girls associated them with getting clarifications and explanations.

Figure 40 provides another example of a knowledge structure associated with *get a clearer picture*. Girl #3 provided the indicator "I can understand more clearly why heroin shouldn't be made legal". Her initial knowledge structure was based on the node "drugs of this nature are not useful", and provided two nodes presenting two conflicting points of view. One viewpoint was expressed in the node "some claim it should be made legal" and the other node expressed the girl's point of view "I feel it should not be made legal".

FIGURE 40
GET A CLEARER PICTURE

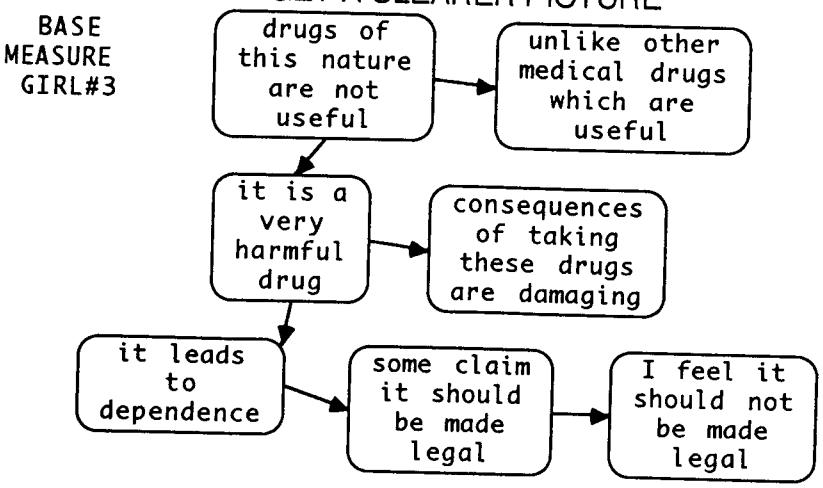
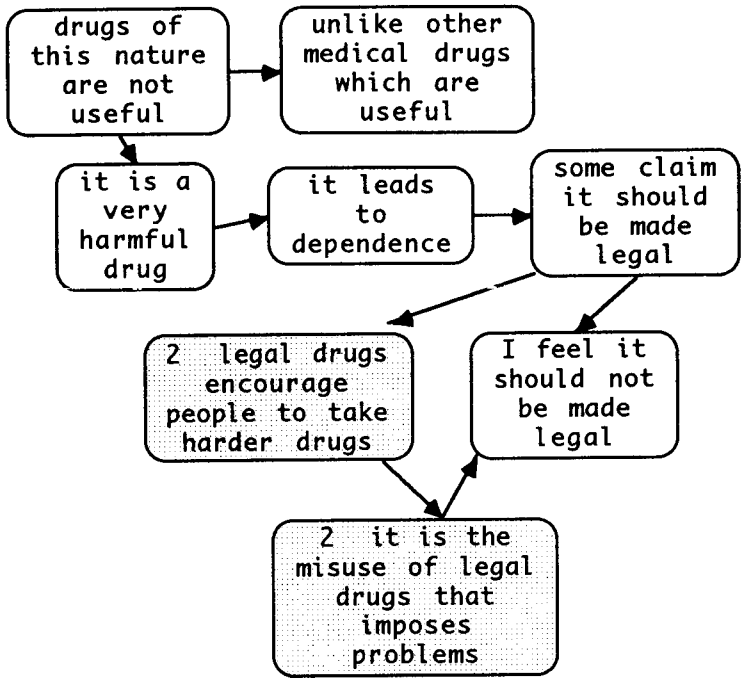


FIGURE 40 (continued)
GET A CLEARER PICTURE

AFTER SECOND EXPOSURE



One change to the girl's knowledge structure appears to be associated with the indicator. Inserted between the nodes "some claim it should be made legal" and "I feel it should not be made legal" were two nodes. The first node presented the outcome of legalisation as "legal drugs encourage people to take harder drugs", and this node, when combined with the node "it is the misuse of legal drugs that imposes problems" appeared to provide the clearer understanding.

5.5.3 *Get a clearer picture*: some patterns

The girls utilised information in order to clarify their existing ideas, enabling them to *get a clearer picture*. The knowledge structures generated in this process showed changes that clarified their existing ideas by providing explanations of how and why. *Get a clearer picture* was also evidenced in revised knowledge structures that reflected more precise details and examples of set membership, and elaborative details such as properties. Table 13 sums up the pattern of cognitive changes and nature of the changed structures for the four girls.

TABLE 13
NUMBER AND NATURE OF REVISED KNOWLEDGE STRUCTURES:
GET A CLEARER PICTURE

REVISED KNOWLEDGE STRUCTURES	GIRL 1 *n*	GIRL 2 *n*	GIRL 3 *n*	GIRL 4 *n*	TOTAL *n*
explains how (inserting)	2	1	4	1	8
explains why (inserting)	2	0	3	2	7
set membership details (appending)	3	0	2	2	7
properties (appending)	2	0	2	1	5
TOTAL	9	1	11	5	27

n = the number of types of revised knowledge structures identified

1. *Get a clearer picture* was associated with 14 instances of inserting and 12 instances of appending.

2. *Get a clearer picture* was associated with revised knowledge structures that could be characterised as explanatory structures telling "how" that were developed through inserting.

3. *Get a clearer picture* was associated with revised knowledge structures that explained "why", also developed through inserting.

4. *Get a clearer picture* was associated with revised knowledge structures displaying precision through set membership and through elaborating properties, developed through appending.

5. Most of the girls employed both appendings and insertings to *get a clearer picture*, and there was little difference in the number of times the girls employed these cognitive strategies. One girl, however, recorded only one case of the effect, and this was through inserting.

5.6 GET A VERIFIED PICTURE

5.6.1 Description of the effect

The conversations with the girls made it apparent that they were able to utilise the information to verify their existing ideas, especially where some doubt

existed in their minds about the certainty of these ideas, and even though on the surface the ideas appeared stated as certain. In doing so, this enabled them to remove doubt about, or establish with more surety, an existing idea. This effect has been labelled *get a verified picture.*

As shown in Table 3 (p. 179), all the girls gave some indicators as evidence that they utilised information in order to verify aspects of their existing knowledge. The extent (17) of doing this however was less than the other perceived effects.

Table 14 shows the number of these indicators associated with each exposure.

TABLE 14
NUMBER OF INDICATORS: GET A VERIFIED PICTURE

STAGES	GIRL 1 *n*	GIRL 2 *n*	GIRL 3 *n*	GIRL 4 *n*	Total *n*
DEBRIEFING	2	1	3	1	7
EXPOSURE 1	1	0	2	0	3
EXPOSURE 2	3	1	1	0	5
EXPOSURE 3	0	1	0	1	2
TOTAL	6	3	6	2	17

n = number of indicators of *get a verified picture* provided in written and verbal responses recorded after each exposure, and in the debriefing session.

There was also some difference in the number of indicators. The debriefing sessions provided the most number of indicators (7), and the second exposure provided the most indicators (5) of all of the exposures, and the third exposure provided the least number (2). Not all of the exposures provided indicators. Girl #2 and Girl #4 provided no indicators after the first exposure; Girl #4 provided no indicators after the second exposure, and Girl 1# and Girl #2 provided no indicators after the third exposure.

The indicators of this perceived effect were expressed in the following ways by the girls: "it confirms some of the guesses I've made, like when I started writing the first time, you think you know something but are not certain and then the information tells you that it is"; "the information told me some things I already knew. I guess it tells me I was right"; "it confirms what I already know, especially when you think you know something though you're not feeling

100% certain", and "it sort of gives more certainty to what you think; that's a general thing; it confirms my own ideas".

The girls were also able to cite specific examples of this effect, providing indicators like: "it confirmed that it cost a lot"; "it strengthens my ideas - like the importance of drug education"; "however, I still believe that heroin has a great effect on personality, more so now since I've read the ideas"; and "you know for certain where before you might have thought something but weren't sure, such as the form heroin comes in". In these statements is also the idea that the information enabled them to strengthen their belief in a particular idea. A full listing of the indicators is found in Table 27 in Appendix 5.

5.6.2 Manifestation of *get a verified picture* in changes to the girls' knowledge structures

This section of the results presents the associations between what the girls said about the effect *get a verified picture* and the changes, or not, to their knowledge structures related to that effect. As with the other indicators of effects, the associations have been derived from the analytical and comparative procedures documented in Chapter 4.4. Table 28 in Appendix 5 provides a working summary of this analysis.

Table 15 shows the number and type of cognitive strategies associated with *get a verified picture*. The analysis of the revised knowledge structures showed that the girls predominantly appended information to their existing knowledge in order to *get a verified picture*. Inserting was less common than appending. In several instances of this perceived effect, there was no evidence of any change to the girls' knowledge structures. Given that this was not evident in the other effects, this is a pattern worth noting.

TABLE 15
NUMBER AND TYPE OF COGNITIVE STRATEGIES:
GET A VERIFIED PICTURE

COGNITIVE STRATEGIES	GIRL 1 *n*	GIRL 2 *n*	GIRL 3 *n*	GIRL 4 *n*	Total *n*
appending	2	4	1	1	7
inserting	1	0	0	0	1
no change	1	0	2	0	3
TOTAL	4	4	3	1	12

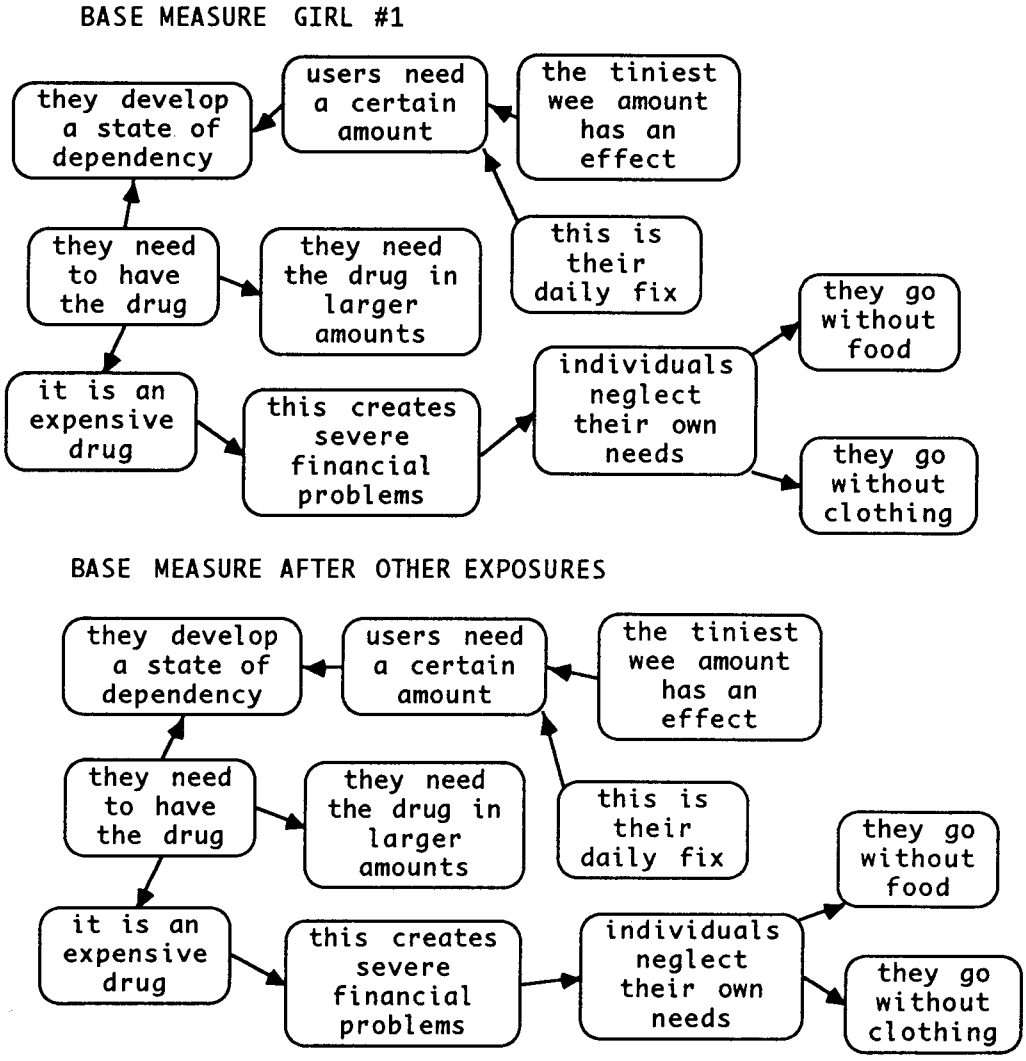
n = the number of cognitive strategies identified for each girl

An analysis of the knowledge structures associated with *get a verified picture* show the following conceptualisations of the revised knowledge structures: no change, emphatic change, inclusive change, and defensive change. Each of these is described in turn. However, it is acknowledged that these conceptualisations are tenuous, having been derived from a small number of instances.

5.6.2.1 Revised knowledge structures: no change

In some cases for the girls, a perceived effect was not associated with any change to their knowledge structures. For example, Girl #1 indicates "it confirmed that it [heroin] cost a lot". Figure 41 shows her knowledge structures associated with this indicator.

FIGURE 41
GET A VERIFIED PICTURE: NO CHANGE



This knowledge structure did not change during any of the exposures to information, even though an effect was perceived. One possible explanation for this might be that in her mind, the girl had some doubts or uncertainties about the cost, yet explicitly stated that heroin was an expensive drug, despite these uncertainties. She may have been guessing, perhaps based on general knowledge of other drugs. The information in the second exposure did specify an amount of cost, $2,000 - $10,000 per week, and this figure may have enabled her to confirm her uncertainties. This interpretation is consistent with one of her more general indicators: "it confirms some of the guesses I've made, like when I started writing the first time, you think you know something but are not certain and then the information tells you that it is". While this guess may have been expressed tentatively as a fact, there was no basis for identifying this distinction of guess and fact in the knowledge structures, unless the girl explicitly stated them. Another possible explanation might be that she actually knew that it was expensive, and the figures reinforced this certainty.

Another example, not illustrated here, also comes from Girl #1. She indicated "I got some of the effects right, like weight loss and loss of vitality". In her initial knowledge in relation to these particular effects she provided the nodes "people lose weight" and "people lose vitality". These nodes remained unchanged throughout the exposures, and no further changes were made in relation to them.

In the no change cases, it could be that any doubt about existing ideas in the knowledge structure existed as an implicit notion rather than having been made explicit in the written and verbal responses. While the knowledge structures represented declarative knowledge that appeared to be fixed and certain at a given point in time, this in fact might not have been the case in the minds of the girls. They did not acknowledge their doubts about the accuracy or certainty of their statements in their written responses, and this wasn't established in the interviews or debriefing, and consequently in the mapping of these nodes, they were taken as facts.

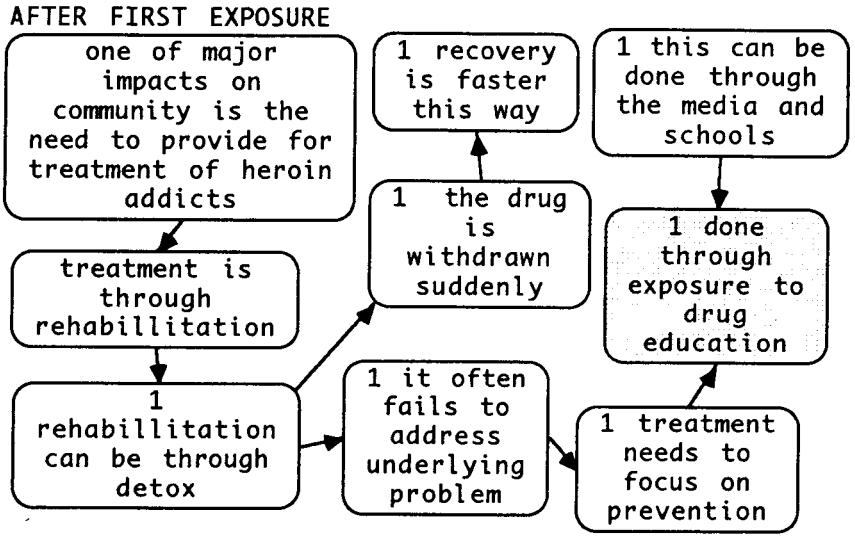
5.6.2.2 Revised knowledge structures: emphatic

In a number of knowledge structures of the girls, there was repetition of nodes which appeared to be used to add weight or emphasis to a particular statement, primarily personal statements.

Figure 42 contains a set of three different examples from Girl #2 illustrating changed structures that show repetition to add emphasis. This girl stated that an effect of the information was "it strengthens my ideas - like the importance of drug education". Several knowledge structures associated with "drug education" were mapped accordingly. In these examples, there was repetition of the notion that the most effective approach to dealing with the problem of drug addiction was the process of drug education. It was expressed in a number of nodes. It appeared first in a structure built around detoxification as a form of treatment, with the nodes "treatment needs to focus on prevention" and "done through exposure to drug education", then later in a structure built around therapeutic communities as an approach to treatment as "this is through social education and drug education". The idea reoccurred as "further drug education is needed" and "need prevention through exposure to problems at school" in a structure that dealt with the penalties for drug use. This repetition appeared to be used to add weight or emphasis to a particular statement, primarily position statements.

FIGURE 42
GET A VERIFIED PICTURE: EMPHATIC

EXAMPLE 1

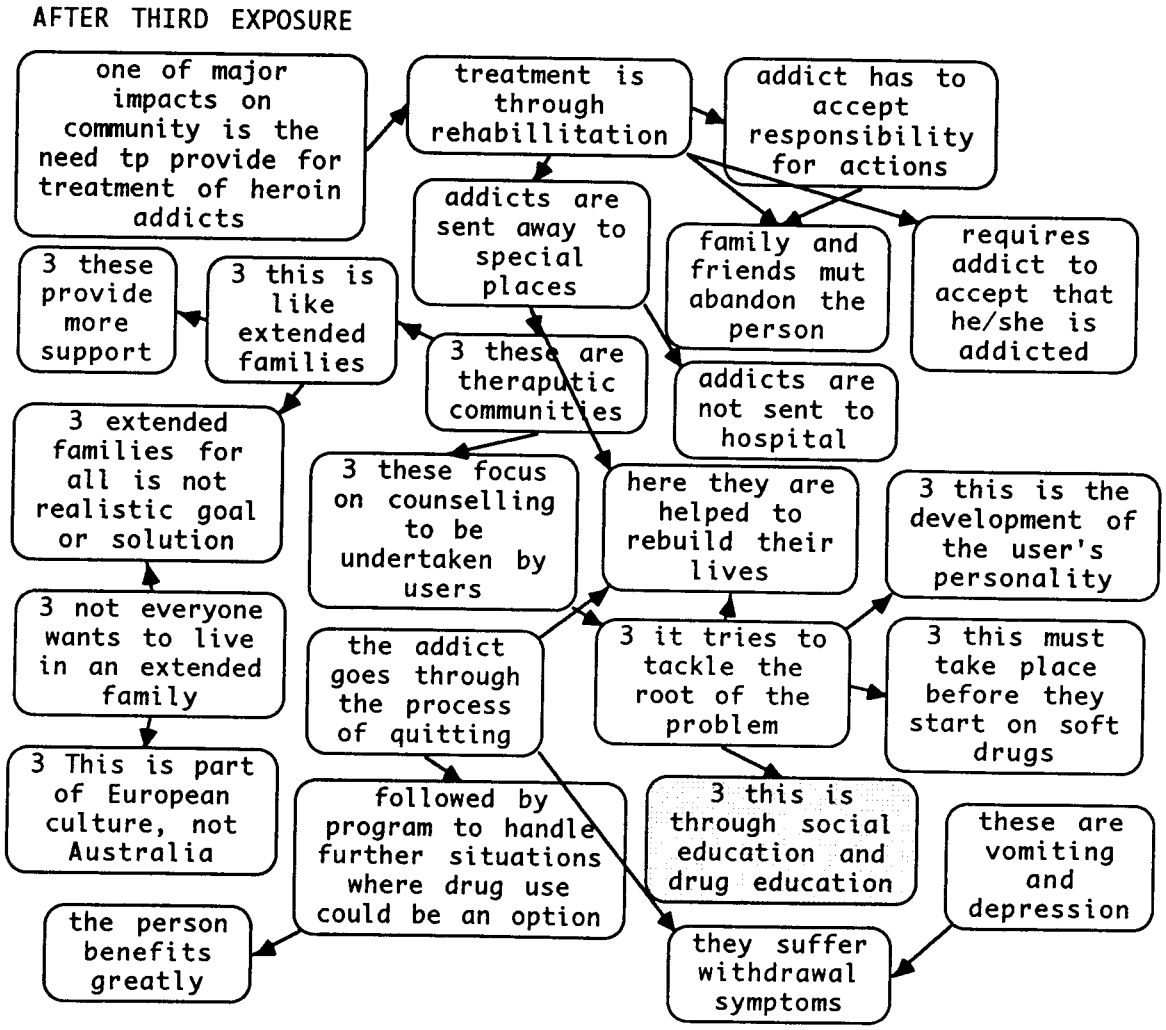


This example shows a structure based on the node "one of the major impacts on the community is the need to provide for treatment of heroin addicts". It focused on treatment in terms of detoxification. After the first exposure to information which dealt with the history of the drug and some of the social consequences, the node "done through exposure to drug education", amongst other related nodes, has been appended.

Example 2 shows another structure for Girl #2 also based on the node "one of the major impacts on the community is the need to provide for treatment of heroin addicts". This structure focuses on therapeutic communities as a form of treatment, and is the structure after the third exposure. The idea of drug education reoccurs (shaded).

FIGURE 42 (continued)
GET A VERIFIED PICTURE: EMPHATIC

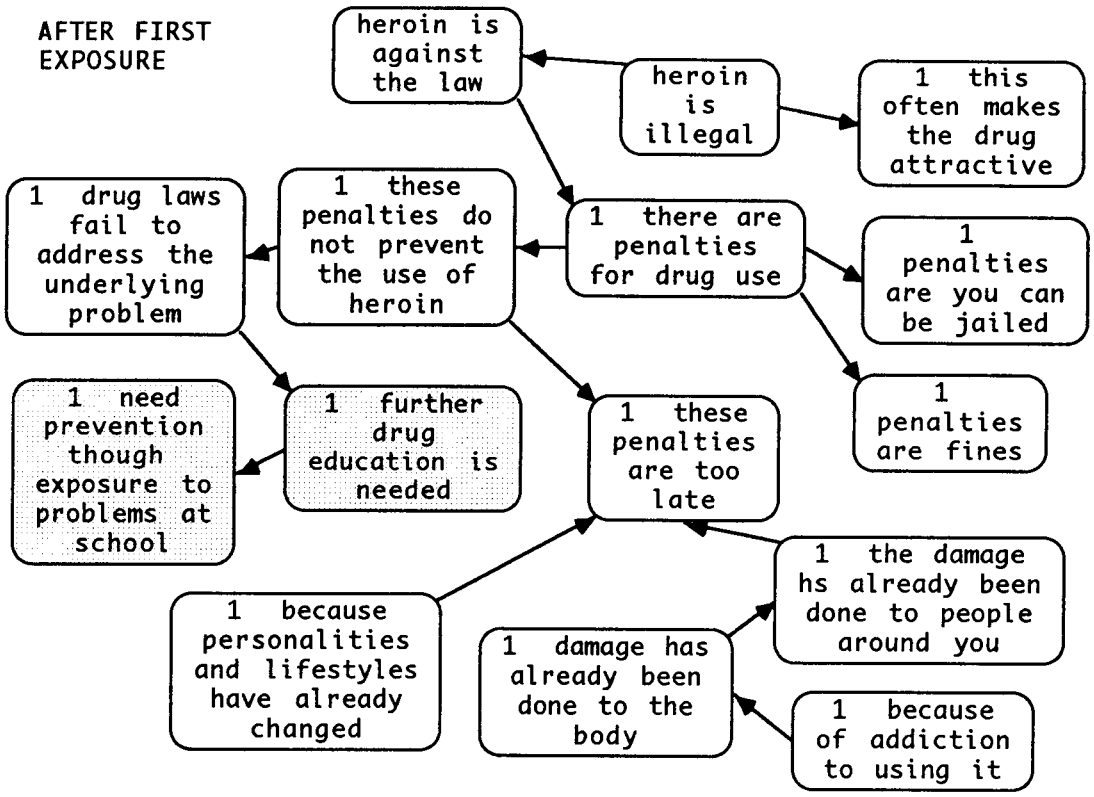
EXAMPLE 2



Example 3 from Girl #2 is from a structure relating to legal aspects of heroin use. The idea of drug education appears here as well, as shown in the nodes "further drug education is needed" and "need prevention through exposure to problems at school" (shaded).

FIGURE 42 (continued)
GET A VERIFIED PICTURE: EMPHATIC

EXAMPLE 3

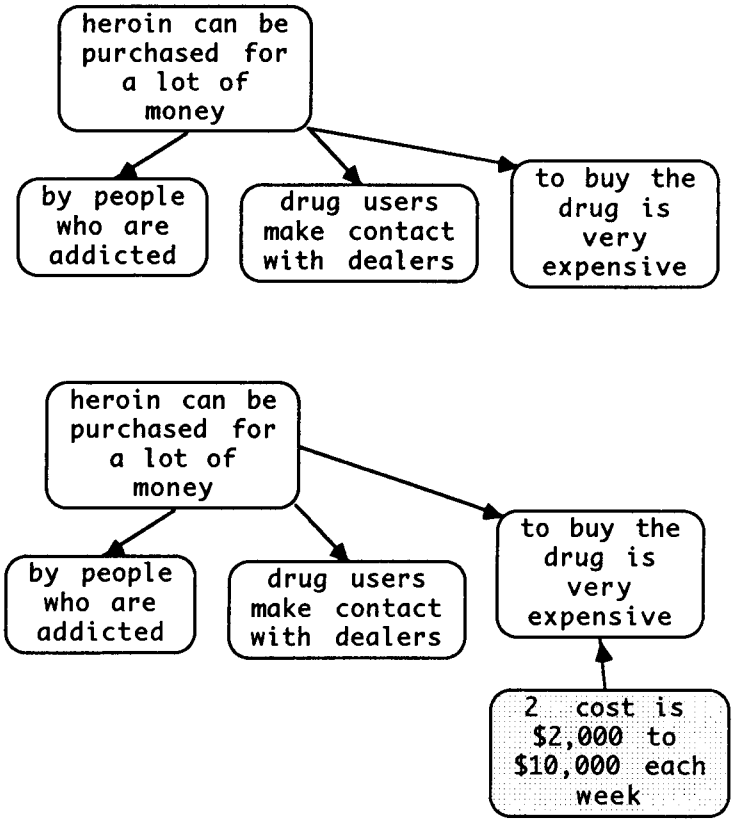


For this girl, this deliberate restatement cumulated to a strongly stated view which pervaded her responses. This change was labelled as an emphatic change.

5.6.2.3 Revised knowledge structure: inclusive

In a few instances, some of the revised knowledge structures associated with the effect *get a verified picture* showed the inclusion of specific detail. Verification was shown through appending more precise, specific ideas, that is, specifying the members of a more inclusive class. Figure 43 from Girl #3 is a simple example of this.

FIGURE 43
GET A VERIFIED PICTURE: INCLUSIVE



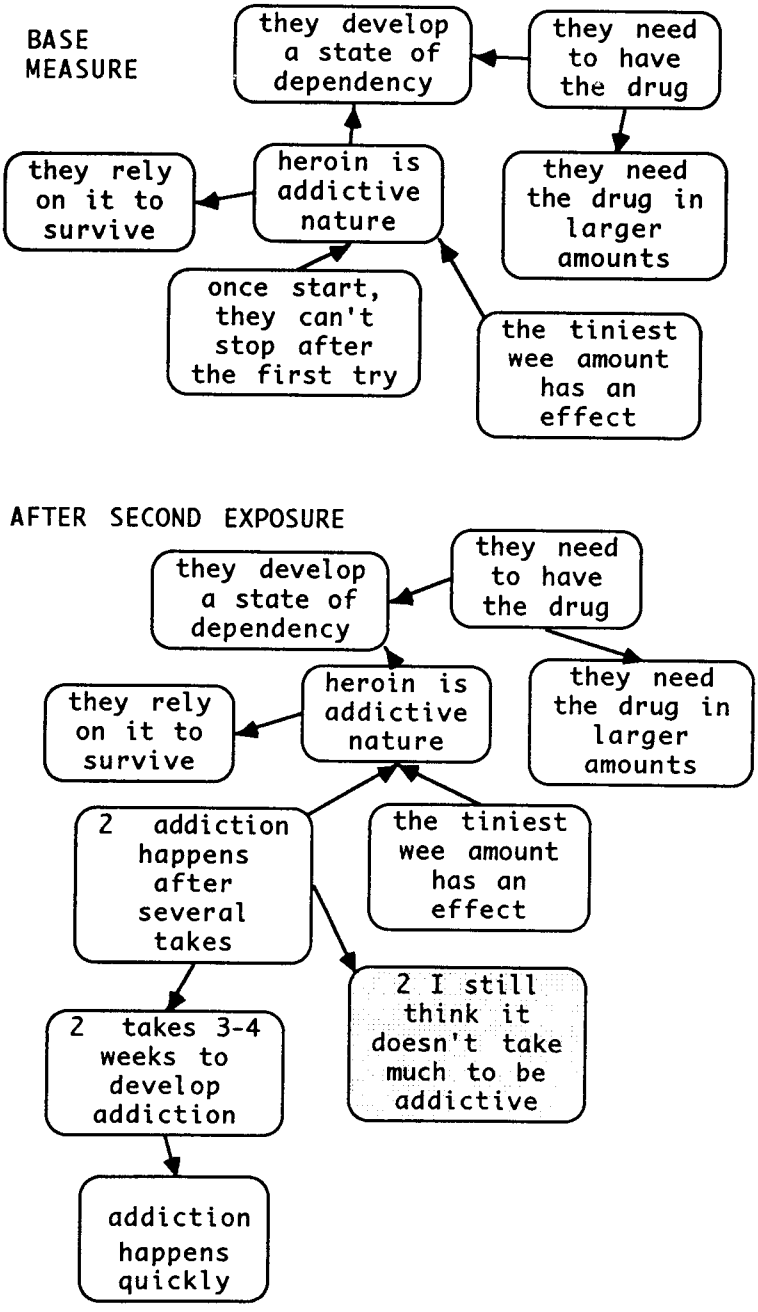
The structure shown here was part of a structure about implications of heroin use for the individual. It was associated with the indicator "it confirmed that heroin is expensive to buy". The effect of getting a verified picture was brought on by appending the node "cost is $2,000 to $10,000 each week" to the node "to buy the drug is very expensive". The appended node was more specific and precise to "to buy the drug is very expensive" and the node "heroin can be purchased for a lot of money". In this case, the effect of *get a verified picture* is associated with a change in structure where more specific detail is added.

5.6.2.4 Revised knowledge structure: defensive

In a small number of instances, a change of facts encouraged the girls to defend and reaffirm a viewpoint based on the facts before they were changed in their knowledge structures. This is illustrated in Figure 44.

The knowledge structures in Figure 44, by Girl #1, were part of a substructure based on the organising concept "Implications for the individual". It is an example of verification where the appended change is characterised as a defensive change. Some of the facts have been changed, however, the original position statement is reinforced, particularly through the word "still".

FIGURE 44
GET A VERIFIED PICTURE: DEFENSIVE



The initial set of facts was the basis for a viewpoint being stated in the initial knowledge structures. The change of facts did not bring about a change of viewpoint, rather, a viewpoint based on the pre-change ideas was now made more explicit after the change.

5.6.3 Get a verified picture: some patterns

Table 16 shows the different types of structural changes identified by each girl.

TABLE 16
PATTERNS OF GET A VERIFIED PICTURE

REVISED STRUCTURES	GIRL 1 *n*	GIRL 2 *n*	GIRL 3 *n*	GIRL 4 *n*	TOTAL *n*
Emphatic	0	3	0	0	3
Inclusive	2	1	0	1	4
Defensive	1	0	1	0	2
No change	1	0	2	0	3
TOTAL	4	4	3	1	12

n = the number of each type of revised knowledge structure for each girl

The changes to knowledge structures associated with the effect of verification are quite different for each of the girls. Given the small number of instances, however, no clear patterns can be established. After the various exposures, the girls appeared to show some of the changes associated with this effect.

In summary, utilising the information in the exposures enabled the girls to confirm the truth or correctness of existing ideas: to remove doubt, establish more surety, or strengthen belief in a particular area. Overall, *get a verified picture* might be seen as a continuum of verification: sometimes for the girls it meant moving from doubt to certainty; sometimes it enabled them to confirm their existing knowledge; and sometimes it strengthened their belief in their existing position or knowledge and reinforced their standpoint. The effect of *get a verified picture* is associated with some patterns of changes to their knowledge structures. The changes identified tend to suggest the intention of the verification. For example, emphatic change reiterates an idea, perhaps showing the strength of the conviction of that idea.

5.7 GET A POSITION IN A PICTURE

5.7.1 Description of *get a position in a picture*

As shown in Table 3 (p.179), all the girls provided evidence that the information in the exposures enabled them to form an opinion or state a viewpoint. This effect was conceptualised as *get a position in a picture.* 29 indicators were provided for this effect. What is notable here is the number of indicators of this effect provided by Girl #2, who provided over half (17) of those stated (29). This is also the highest number of the indicators for any of the effects. Girls #1, #3 and #4 provided only small numbers of indicators of this effect.

Table 17 shows the number of indicators of this effect for each girl after each stage of the research.

TABLE 17
NUMBER OF INDICATORS: *GET A POSITION IN A PICTURE*

EXPOSURES	GIRL 1 *n*	GIRL 2 *n*	GIRL 3 *n*	GIRL 4 *n*	TOTAL *n*
DEBRIEFING	0	3	3	2	8
EXPOSURE 1	2	4	1	0	7
EXPOSURE 2	1	5	1	1	8
EXPOSURE 3	0	5	0	1	6
TOTAL	3	17	5	4	29

n = numbers of indicators of *get a position in a picture* provided in written and verbal responses recorded after each exposure, an in the debriefing session

The girls indicated that they have utilised the information to express an opinion about the pictures they had built up, or to state a view or estimation of their pictures, either as a personal value judgement, a guess, an inference or as an intellectual conclusion. They made general comments such as: "you can develop your own view where you stand in relation to an idea"; "I'm able to make a conclusion, that is I can put all the ideas together and make a general statement"; and "you can make comment on things - you've got enough information to express an opinion".

Some of the more specific indicators, tied to specific content, included: "I was surprised that artists and poets used heroin. I didn't think that they would be able to think logically as it affects their brain cells"; "I can draw a conclusion

eg heroin and driving"; "I understand her point when she says that extended families provide more support, but I feel that extended families for all is not a realistic goal or solution to the heroin problem. Again I'm able to make this point"; "helps me express an opinion based on fact. When I got the facts on treatment I could state which one I thought was best". These examples suggested that *get a position in a picture* was all about taking a stand; being able to take ideas to an end point; being able to derive and state conclusions; being able to see multiple perspectives based on the existing ideas; and being able to look over a set of ideas and offer some reflection on them. Here the girls were able to provide comment on the embedded information. These comments were sometimes expressions of agreement or disagreement with ideas presented; at other times a proposal for a potential course of action; presenting conditional constraints, or an explanation of a stand taken. The knowledge structures thus became personalised through the girls leaving their personal stamp on the ideas. A full listing of the indicators is found in Table 29 in Appendix 5.

5.7.2 Manifestation of *get a position in a picture* in changes to the girls' knowledge structures

This section of the results presents the associations between what the girls said about the effect *get a position in a picture* and the changes, or not, to their knowledge structures related to that effect. As with the other indicators of effects, the associations have been derived from the analytical and comparative procedures documented in Chapter 4.4. The summary of this analysis is presented in Table 30 in Appendix 5. Table 18 shows the number of cognitive strategies for each girl to *get a position in a picture*.

TABLE 18
NUMBER AND TYPE OF COGNITIVE STRATEGIES:
GET A POSITION IN A PICTURE

COGNITIVE STRATEGY	GIRL 1 *n*	GIRL 2 *n*	GIRL 3 *n*	GIRL 4 *n*	TOTAL *n*
inserting	0	1	0	0	1
appending	2	14	2	1	19
no change	0	2	0	1	3
Total	2	17	2	2	23

n = the number of cognitive strategies for each girl. Note, some different indicators refer to the same content

The changes to their knowledge structures associated with this effect were mainly by appending. The analysis also indicated that in most cases, *get a complete picture*, *get a changed picture* and / or *get a clearer picture* appear to take place before *get a position in picture*. These initial changes appeared to provide the opportunity for positioning in a picture through building up a substantial knowledge base for making a judgement or comment. In all but a few cases, nodes showing position statements were appended.

The changed knowledge structures are described below. The changes have been conceptualised as: (1) reactive; (2) formative; (3) potential positioning; and (4) predictive. It is again acknowledged that these conceptualisations have been derived from a small number of cases.

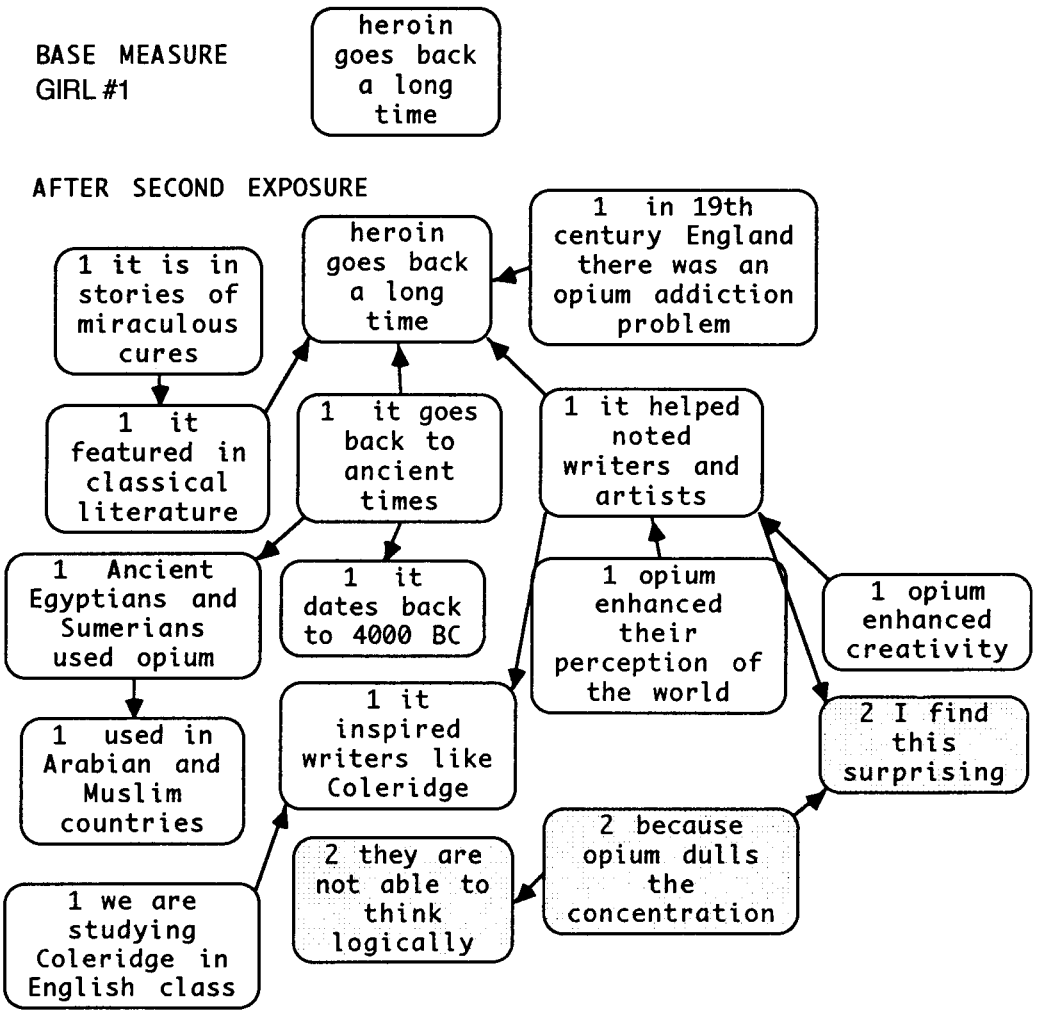
5.7.2.1 Revised knowledge structures: reactive

In some instances, the knowledge structures identified with the perceived effect had a position statement appended that expressed a reaction to a newly created knowledge structure. The girls reacted by expressing agreement or disagreement with some of the ideas that they had incorporated into their structures. Agreement in some cases was often accompanied by statements showing amazement, surprise, or astonishment at these ideas, for example, "I was surprised that ..." and "I cannot believe that ..." In these cases, there seemed to be acceptance of the ideas, but also a recognition that these facts were not necessarily the expected facts. In a few cases of this change, part of the structures contained not only position statements, but also statements of justification of the position, often based on information in the exposures. This was particularly the case where the reactive change showed disagreement with some knowledge in the structure. These cases of changed knowledge structures were conceptualised as reactive changes.

The example in Figure 45 by Girl #1 illustrates this change. The indicator of the perceived effect was: "I was surprised that artists and poets used heroin. I didn't think that they would be able to think logically as it affects their concentration". Here this girl was stating a reaction in the form of a value judgement. Her knowledge structure associated with this effect underwent a number of changes. The first change was made by appending a large substructure about the history of heroin derived from the first exposure. Part of this included a sequence of nodes based on "it helped noted writers and

artists". This node was expanded by identifying Samuel Taylor Coleridge as an opium user, and two nodes that identified how the use of opium helped: "opium enhanced creativity" and "opium enhanced their perception of the world". The position statement "I find this surprising" was appended after the second exposure, and was based on the reason "because opium dulls the concentration", with the consequence "they are not able to think logically". The reason and consequence appeared to be facts derived from the second exposure. *Get a position in the picture* seemed to be enabled by the following sequence: appending -> get a complete picture -> get a position in the picture.

FIGURE 45
GET A POSITION IN A PICTURE: REACTIVE

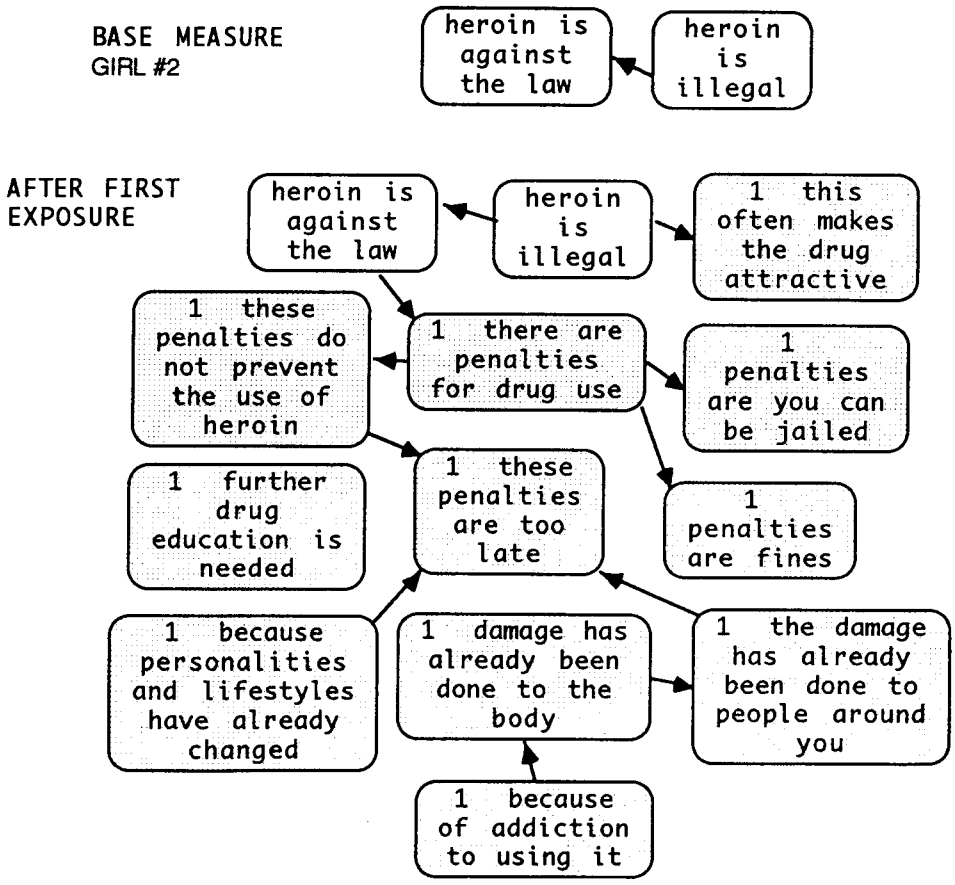


5.7.2.2 Revised knowledge structure: formative change

In a small number of instances, the revised knowledge structures of the girls showed a formative change. This was where they stated a personal conclusion based on the facts provided in the exposure. They seemed to demonstrate the girls' ability to analyse and synthesise information to develop a logical conclusion.

The example by Girl #2 in Figure 46 illustrates a revised knowledge structure showing a formative change. The indicator associated with this change was "I feel that expensive fines and penalties do not effectively stop drug use". The initial knowledge structure contained two nodes stating essentially the same idea of the legal status of heroin. After the first exposure, a number of facts about penalties were appended, as well as a sequence of statements constructed around the conclusion "these penalties are too late".

FIGURE 46
GET A POSITION IN A PICTURE: FORMATIVE



5.7.2.3 Revised knowledge structures: potential positioning

In a few cases, the revised knowledge structures of the girls provided no evidence of a statement of a position associated with some indicators of *get a position in a picture*. In the analysis of the sequence of associated knowledge structures, no position statements were appended or inserted, while other changes were made to the structure. These indicators of the effect generally acknowledged the potential to be able to use the set of facts and their relations in some future time to construct a case or an argument, to present a viewpoint, or put them to some other use. While in the first instance the facts in the revised structure could be regarded as *get a complete picture*, however, to the girls these served another purpose, that is, *get a position in a picture*. The collected set of facts represented for a knowledge base for future, potential positioning.

An example of this is in Figure 47, a part of Girl #2's revised knowledge structure on the specific effects of heroin. She had said the information "gives me an argument eg heroin and pregnancy for girls who want to take heroin. I may be talking about this sometime with them, and can state my opinion based on a good argument".

FIGURE 47
GET A POSITION IN A PICTURE: POTENTIAL POSITIONING

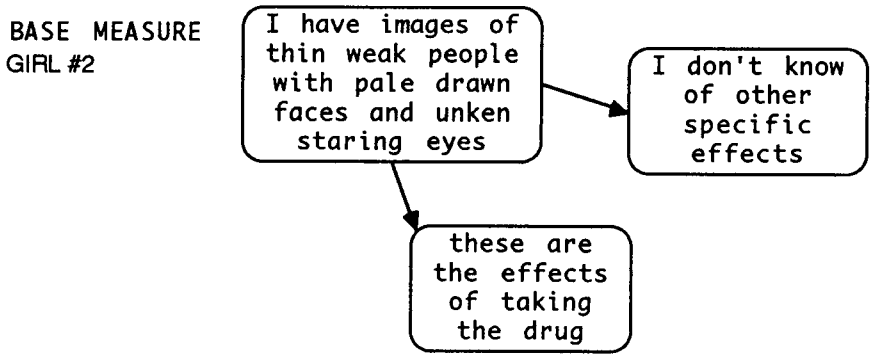
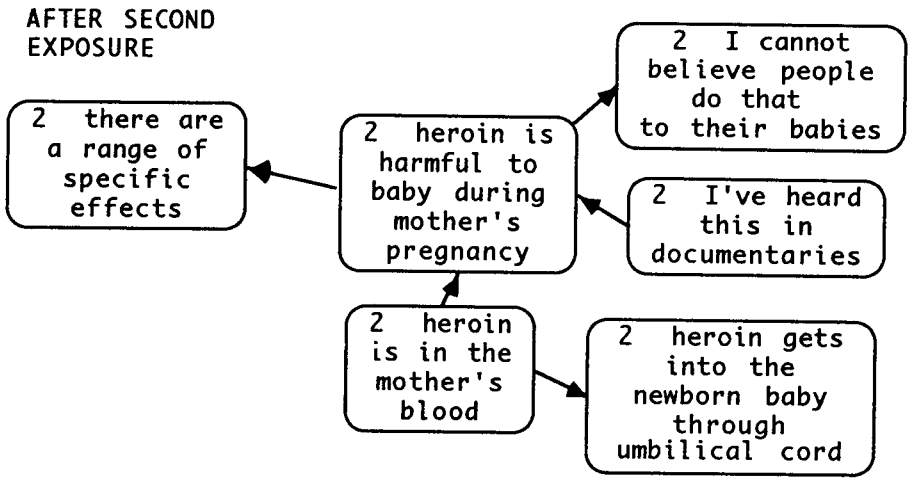


FIGURE 47 (continued)
GET A POSITION IN A PICTURE: POTENTIAL POSITIONING



The perceived effect suggested that the revised knowledge structure could enable the construction of an argument which would become a position statement for use at some future time. The "opinion" was not explicitly shown in the revised knowledge structure; the changed knowledge structure was a set of facts about the effects, brought about by getting changed and complete pictures. In the indicator, the girl acknowledged the potential to be able to use these facts and their relations in some future time to construct a case - an argument, present a viewpoint or put them to some other use. The collected set of facts represented the potential for future positioning.

This example also has a position statement appended to it, in the node "I cannot believe people do that to their babies". This position statement seemed to be associated with the indicator "it caused a reaction eg. people harming their babies through heroin". The position statement was not one of denying or rejecting the facts, but a statement of amazement and astonishment because such an effect was unexpected. It was a reaction based on the girl's notion of human nature and human decency.

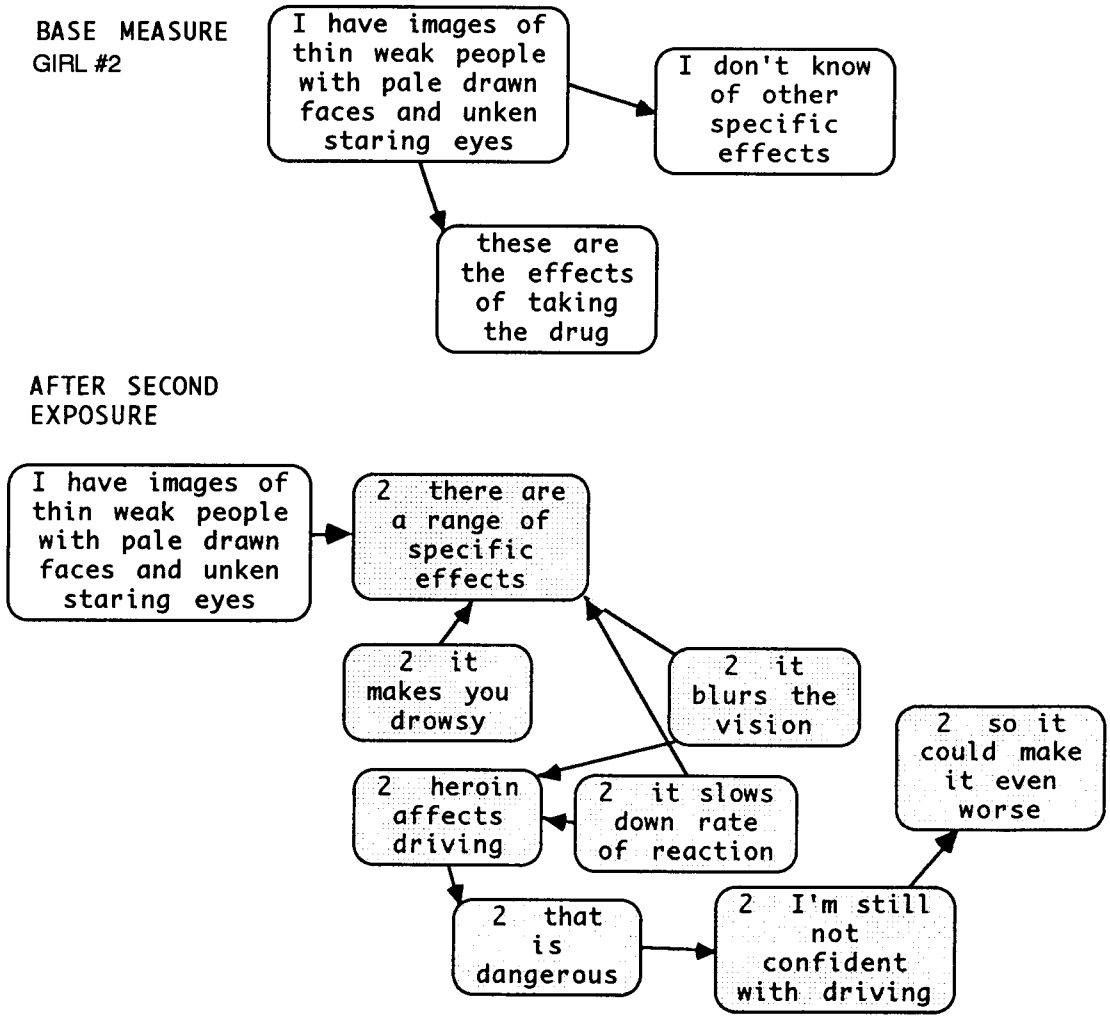
5.7.2.4 Revised knowledge structures: predictive

In a very small number of instances, the revised knowledge structures of the girls associated with this effect presented position statements where new events and states were predicted; the existing facts were used to state a

position, and the circumstances of that position were used to predict further impacts.

The example by Girl #2 in Figure 48 shows revised knowledge structures with both predictive and reactive changes. The indicator of the effect was "I can draw a conclusion, eg. heroin and driving". This effect was associated with a number of changes to her knowledge structure constructed in relation to the specific effects of heroin. In the analysis of the revised knowledge structure, the effect was brought on by the appending of facts to first *get a complete picture*, from which the position statement was derived, and then appended. It was expressed in the following sequence: appending -> get a complete picture -> appending of position statement.

FIGURE 48
REVISED KNOWLEDGE STRUCTURE: PREDICTIVE



5.7.3 *Get a position in a picture*: some patterns

Patterns that have been suggested here are tentative, given the limited number of changes identified. Reactive changes were the most common characterisation of the changed structures associated with the indicator *get a position in a picture.* While all girls showed evidence of reactive changes, Girl #2 in particular showed a substantial number of reactive changes. This girl also clearly acknowledged the potential for her knowledge structures to represent some future positioning and judgement. Overall, formative and predictive changes occurred to a limited extent. Appending was the primary cognitive strategy associated with *get a position in a picture.*

5.8 OVERALL SUMMARY OF PATTERNS

There is not an even distribution of indicators, both in terms of the number of effects identified, and the type of effects. Overall, Girl #4 identified considerably fewer indicators (24) as compared to the other girls (with 36, 41 and 39 respectively). The dominant effect, by frequency, for each of the girls was: Girl #1 - get a complete picture; Girl #2 - get a position in a picture; Girl #3 - get a clearer picture; and Girl #4 - get a complete picture. The various effects were associated with distinctive characterisations of the revised knowledge structures, as shown in the following summary in Table 19:

TABLE 19
SUMMARY OF FINDINGS

Type of effect: cognitive information utilisation	**Types of changes in knowledge structures**	**Predominant cognitive strategy**
get a complete picture	(a) inclusive (b) elaborative: property-oriented structures; manner-oriented structures, cause-oriented structures, goal-oriented structures (c) integrative	primarily appending, with some inserting
get a changed picture	(a) construction (b) deconstruction (c) reconstruction	initially appending, then deleting then appending

TABLE 19 (continued)
SUMMARY OF FINDINGS

Type of information utilisation	Types of changes in knowledge structures	Predominant cognitive strategy
get a clearer picture	(a) explanation tells how tells why (b) precision	inserting and appending
get a verified picture	(a) no change (b) emphatic (c) inclusive (d) defensive	appending; in several cases, no change processes appear to be operating
get a position in a picture	(a) reactive (b) formative (c) representative (d) predictive	appending; for some, there are no changes in structure

The second exposure to information appeared to generate the most indicators of effects. There are a number of possible reasons for this. It may have been related to the nature of the information of the second exposure. This information described the immediate and long term effects of heroin use on the person. It was information about people, and this may have given it greater relevance and personal attention. It may be a product of the research design. After the first exposure, and its associated written and verbal responses, the girls may have become more familiar and comfortable with the requirements of the research through having learned the process, and this may have prompted greater mental activity on their part. It may be that by the time of the third exposure, the girls may have felt tired and exhausted by the long process, and thus their output may not have been as extensive as was evident in the second exposure. This order effect opens up a line of inquiry for future research.

Another interesting feature emerges in relation to the revised knowledge structures, related to the provision of specific details, that is, knowledge structures detailing set membership. These structures were associated with a number of different effects. On some occasions, revised knowledge structures showing set membership were associated with getting a complete picture; on other occasions, they were an essential stage of getting a changed picture and were seen in the context of change rather than completeness; on some occasions they were associated with verification and confirmation.

CHAPTER 6

CONCLUSION AND IMPLICATIONS

6.1 INTRODUCTION

This chapter presents the conclusions of the study, discusses its implications and applications, and identifies some possible directions for future research. The study focused on understanding concepts of cognitive information utilisation from the perspective of four girls. Specifically it examined cognitive information utilisation as the effects of information exposure in two ways: firstly, from the perceived effects as stated by the girls, and secondly in terms of the changes in knowledge structures associated with the indicators of these perceived effects.

6.2 SUMMARY OF FINDINGS AND DISCUSSION

It is clearly evident from the examination of the evidence of their stated perceptions and their associated knowledge structures that the exposures to information and the deliberate consideration of this information has had effects for all the girls. Within the limits of the group, quasi-experimental approach and procedures employed in this study, a number of types of effects have been perceived by the girls in relation to utilising the information in the different exposures, and these types were manifested in distinct patterns of changes to knowledge structures. There is coherence between the effects, and how these effects were manifested in changes to the girls' knowledge structures.

Table 31 summarises the types of perceived effects, the types of changes to the knowledge structures that are associated with these different effects, and the predominant cognitive strategies employed by the girls to change their

knowledge structures. The effects were conceptualised as "pictures". This term, expressed a number of times by the girls when they described the perceived effects of the information exposure, formed the basis for categorising the types of perceived effects. Against the framework of Brookes' Fundamental Equation, these effects represent types of cognitive information utilisation.

TABLE 31
SUMMARY OF FINDINGS:
COGNITIVE INFORMATION UTILISATION

Type of cognitive information utilisation	**Types of changes in knowledge structures**	**Predominant cognitive strategy**
get a complete picture	(a) inclusive (b) elaborative: • property-oriented structures • manner-oriented structures • cause-oriented structures • goal-oriented structures (c) integrative	primarily appending, with some inserting
get a changed picture	(a) construction (b) deconstruction (c) reconstruction	initially appending, then deleting then appending
get a clearer picture	(a) explanation • tells how • tells why (b) precision	inserting and appending
get a verified picture	(a) no change (b) emphatic (c) inclusive (d) defensive	appending; in several cases, no change processes appear to be operating, with no changes identified
get a position in a picture	(a) reactive (b) formative (c) potential positioning (d) predictive	appending

The discussion of the findings will be based on the three aspects shown in Table 31. Discussion will firstly place these findings in the context of current

understanding as presented in the literature, and will then address general issues and concerns.

6.2.1 The perceived effects: types of cognitive utilisation

Five types of cognitive information utilisation have been identified in this study, operationalised as perceived effects of the exposures to information. As indicated in the literature review, limited attention has been given to establishing a set of constructs to indicate types of cognitive information utilisation. While there are a number of scales related to classifying types of *information utilisation and nonutilisation, (distinguishing for example* purposes of utilisation, types of use, and levels of use), the constructs tend to be expressed very broadly as instrumental, conceptual and symbolic information utilisation. These constructs have permeated the field, and findings have tended to be matched to these constructs. Because of their settings, the scales also have tended to focus on documenting the extent of occurrence of these broad constructs, with particular emphasis given to documenting observable organisational behaviours, rather than internal cognitive dimensions. However, the findings of this study do appear to support some of the information utilisation constructs already established in the knowledge utilisation literature.

At a general level, some of the stages that the girls have gone through support some of Larsen's seven utilisation alternatives (Larsen, 1985), not in the sense of action-oriented outcomes, but as stages of the process. As in Larsen's study, the girls clearly considered and rejected some information. They made decisions regarding certain features of information based on their frames of reference, as elaborated later. In some instances, information was represented in the form in which it was originally presented, that is, some information presented in the written responses directly resembled some information presented in the exposures. However, this study has moved beyond general measures of the extent of information utilisation to understanding more deeply the nature of cognitive information utilisation.

Similar to Larsen's work, the Levels of Use of the Innovation (LoU) established by Hall, Loucks, Rutherford & Newlove (1975) and Hall & Loucks (1977) focus on measuring the extent of implementation of information from

non-use to complete use, and in the context of organisational innovation. The girls in this study show some evidence of similar levels of use. There was clear evidence of non-use (Level 0), in that not all of the information in the exposures was incorporated into the existing knowledge. There was evidence of what might be described as Refinement (Level IVB) where variations were made to the original information, and change initiated. This was shown in the fact that the girls did not merely replicate the information provided to them; rather they manipulated the information for a variety of purposes. There was evidence of Integration (Level V), where existing knowledge was combined with the new information, where isolated ideas were brought together as a related whole, where modifications were made to the information, and where the outcome was a new organisation of information. This was shown both in terms of the cognitive strategies of appending, inserting and deleting, as well as by the unique types of knowledge structures created by the girls. There was also evidence of Renewal (Level VI), where there was evaluation of the information, expressed by the girls in the form of position statements.

Given that the participants and research contexts of this study and those of Hall, Loucks, Rutherford & Newlove (1975) and Hall & Loucks (1977) were markedly different, such a comparison as this might be considered to be quite tenuous. Their studies focused on physical, observable, end-state behaviours, impact, utility, and changes in policy and programs largely in an organisational context, rather than on cognitive actions and cognitive change. Adults were studied rather than adolescents. However, the findings do contribute to the cumulation of consistent patterns across different contexts, samples and methodologies. The present study is thus an important conceptual extension of the stages of the extent of use, as it characterises the nature of the types of use. A future area of research might be to consider the relationship between the stages or extent of use as identified by Larsen (1985), Hall, Loucks, Rutherford & Newlove (1975) and Hall & Loucks (1977), and the types of cognitive information utilisation at each of these stages. Such research would contribute to integrating and enriching the diversity of findings that characterise the conceptual area, and contribute to theory building. It would also further address the concern expressed by Rich (1991) that the field has not moved beyond the primitive distinctions between conceptual and instrumental utilisation.

The studies of Weiss & Bucuvalas (1980) and Weiss (1986) identified a number of constructs that could be considered as cognitive information utilisation. These include: "understand", "focus attention", "stimulate", "provide new understandings", "clarify their own thinking", "reorder priorities", "make sense", "offer ideas for future directions", "reduce uncertainties", "create new uncertainties", "provoke rethinking", "provide a sense of how the world works", "justify actions", and "support positions" (Weiss & Bucuvalas, 1980: 305); and "general pragmatic guidance", "legitimation", "sensitivity to new concepts" (Weiss, 1986: 419-420). Some of the constructs that have emerged from this study, and the meanings embedded in these constructs show some similarity to the constructs of Weiss & Bucuvalas (1980) and Weiss (1986). For example, *get a complete picture* and "provide new understandings"; *get a clearer picture* and "clarify their own thinking", "make sense", "provide a sense of how the world works"; *get a position in a picture* and "support positions", *get a verified picture* and "reduce uncertainties", "provide legitimation"; and *get a changed picture* and "provoke rethinking". The current study provides a meaningful framework for bringing together the emerging range of individual indicators of cognitive information utilisation identified in all of these studies. It is not to be seen as a fixed taxonomy, rather the beginning of a more holistic approach to conceptualisation, and moving beyond the notion of "grab bag" conceptualisations identified by Rich (1991: 333).

The findings of the present study also reflect the range of utilities or helps conceptualised by Dervin and colleagues in their studies based on sense-making methodologies, and those presented by Taylor (1991). While the samples, conceptual frameworks, methodologies and operationalisations differ, this study and those of Dervin and associates are similar in that they place importance on the individual actor, conceptualise information utilisation as a cognitive interaction of people and information, and seek to conceptualise cognitive change as an aspect of the interaction. The types of cognitive information utilisation identified in the present study, from a cognitive theoretic perspective, seem to reflect Dervin's notion of cognitive "step-takings" and "gap-bridging" that are part of the constructings people do to make sense of their experiences, derived from a sense-making theoretic perspective (Dervin, 1992: 65, 66, 67). This is shown in the following comparative examples with Dervin's study of patient-doctor interviews

(Dervin et al, 1986: 602): *get a complete picture* and "got instructions, facts" and "got answers to questions"; *get a changed picture* and "got new / altered specified pix" and "got new / altered general pix"; *get a clearer picture* and "could see the road ahead"; *get a verified picture* and "reaffirmed my direction / ideas; and *get a position in a picture* and "acquired position". Similarly, in a study for the California State Library that sought to identify the information needs of Californians and to elaborate ways libraries could usefully help with these needs, a number of help categories were identified, some of which reflect categories of types of cognitive information utilisation identified in this study. Some similarities are: *get a complete picture* and "getting connected to others" and *get a verified picture* and "getting support or confirmation" (as reported in Dervin, 1992: 75).

Taylor (1991) tentatively set up eight classes of "information use", derived in part from the work of Dervin (1983). These categories are "enlightenment", "problem understanding", "instrumental", "factual", "confirmational", "projective", "motivational" and "personal or political". While these categories embody the notions of instrumental, conceptual and symbolic utilisation that have perpetuated the field, they identify some overlapping conceptions such as *get a verified picture* and "confirmational"; *get a clearer picture* and "problem understanding", and *get a complete picture* and "factual".

"Picture" has also been established as an organising construct in Dervin's studies. The notion of "picturing" appears to have been first developed by Carter (1974). Dervin's use of the construct has also incorporated what she called "action verbs" or "verbings", claiming that "process approaches focusing on verbs will engender a new kind of knowledge about the human condition, a knowledge including some of those elusive universals, which pertains not to substance but to process" (Dervin, 1996: 22). In this study, the choice of the label "picture" was not because it fitted with existing research; rather it fitted with the girls. It was their construct. Why the girls chose to express the process in terms of "picture" was not fully established. However, they commented on the dominant role of visual media in shaping their existing knowledge of heroin, and made many references to television images of drug addicts they had seen. It is possible that this influence may have contributed to their selection of this term to express their perceived effects.

The conceptual constructs of cognitive information utilisation from all of these individual studies show considerable variation, both in idea, and in the linguistic expression of those ideas. They highlight both the richness of perceived effects, their uniqueness, and ambiguities as well. Yet as already indicated, there is some overlap in the constructs of the different studies, despite the differences in situational and individual factors. What is emerging across these studies is a common metaphor of people utilising information. The picture metaphor emerging from the empirical evidence of this study confirms the conceptual framework based on "pictures" developed by Dervin. The picture metaphor is useful in integrating and unifying this research from different perspectives, and may be an important step in theory building in this area. Extending the range of such studies further, across different groups of people and methodologies, testing the plausibility of the picture metaphor, establishing semantic consistency, and then synthesising the richness and diversity of the individual cognitive effects into a conceptual taxonomy or model of cognitive effects would constitute a significant advance in our understanding of cognitive information utilisation. The constructs presented in this study could serve as a potential framework for integrating this diversity.

6.2.1.1 Discussion: the perceived effects

A number of observations can be made on these findings about the perceived effects. Firstly, in the process of cognitively utilising information, by getting expanded, or changed, or clearer or verified pictures, or by being able to state positions, the girls seemed to be able to move forward in their own worlds, constructing pictures that reflected their new understandings. The effects as they perceived them were not static, fixed effects. Rather, they were part of an ongoing movement. This notion of movement was implied in the evidence associated with the pictures. Movement was expressed in *get a complete picture* through the pattern of revisions to knowledge structures, especially that of inclusive change -> elaborative change -> integrative change. The model posited for *get a changed picture* suggested movement from construction -> deconstruction -> reconstruction, or from deconstruction -> reconstruction. *Positioning in a picture* also conveyed the notion of cognitive information utilisation as moving on, getting on through the development of knowledge structures showing prediction and future positioning. Once a new type of picture had been constructed, it did not

remain immutable to change. Knowledge was not static. Knowledge itself was temporary and its structures were fluid.

In this sense, cognitive information utilisation as evidenced in this study was a dynamic, evolutionary process. One effect often became the starting point for another. For example, *get complete picture* often became a starting point to *get a changed picture*, *get clearer picture*, or *get a position in a picture*. When information in the exposures was found to conflict with existing knowledge, the existing knowledge was not resistant to being changed. While this study did not explicitly attempt to identify which existing knowledge was resistant to change, there were sufficient examples of deleting to suggest a willingness to change. From the comments made by the girls, they seemed to make the assumption that the information in the exposures was accurate, that it represented current truth. This was not surprising, given that the nature of the information to be provided to the girls had initially raised ethical considerations. Because of the age of the girls, and ethics clearance obligations required of the researcher, parental consent for the girls to participate was required, and parents were informed that the girls would be working with authoritative information. On this basis it is likely that the girls in this study were willing to change their existing knowledge. This opens up two useful lines of inquiry. The first is how perceptions of the truth, accuracy, and / or authority of the information influence the types of cognitive information utilisation that take place. The second is exploring the optimum conditions for conceptual change such as extent of dissatisfaction with existing knowledge and views of plausibility of new information.

Considering the above ideas, cognitive information utilisation in this study might be best conceptualised as a continuum, a continuum that varied for each girl. While an overall pattern seemed to be *get a complete picture -> get a changed picture -> get a clearer picture -> get a position in a picture*, this was not necessarily a universal portrayal of information utilisation. All of the types of information utilisation were actively going on during an information exposure. What was happening in terms of each type was dependent on the interplay of existing knowledge, the task, frames of reference and the information itself. At any one time, some information in an exposure might be facilitating getting a complete picture; other information from that exposure might be creating a changed picture in other parts of the

knowledge structure; and other information might be facilitating the construction of a position statement. There was an ever-changing relationship, a sense of movement. What emerged from the girls' working through the three exposures was a sense of an initial emphasis on being right and reducing doubts and uncertainties, a factual orientation, and then moving to an emphasis on adding value by getting explanations and forming personal opinions and position statements.

This notion of movement is also an important concept in Dervin's sense-making theory. Dervin asserts that seeking, processing, creating and utilising information are sense-making processes through which people take steps to construct sense in constantly changing life situations, and that sense is the product of this process (Dervin, 1991). She claims "what humans are doing when they seek and use something called information is building bridges to facilitate their movements (physical, cognitive, emotional, etc) across a reality (time-space)" (Dervin, 1995: 2). Indeed, expressed in the girls' indicators of the perceived effects of the information exposures were words such as "understand", "relate", "realise", "learned", "explained", and "makes a lot of sense". These words would suggest that the types of information utilisation identified for these girls were all about making personal sense.

In thinking of cognitive information utilisation as a continuum, it might be thought of as a personal process of adding value to one's existing knowledge. Taylor's notion of value-added processes is relevant here. His analysis of information systems such as libraries, management information systems, and indexing and abstracting services highlights activities undertaken by these systems to strengthen the potential utility of information. His focus is on external, physical systems (Taylor, 1986). Cognitive information utilisation is a process of adding value to one's existing knowledge for future use. While the information in the exposures carries potential for value, this value is realised through individuals cognitively doing something with it - getting complete, changed, clearer or verified pictures, or getting a position in a picture. The outcome is the enhancement of, or adding value to, existing internal knowledge.

A second set of observations emerging out of the identification of the perceived effects relates to the role of frames of reference. The present study

suggests that information utilisation is not random acquisition nor total acquisition of information that is provided purposefully in information exposures. People are not passive receptacles into which information can be poured and absorbed in toto, and it cannot be assumed that people will absorb all the information to which they are exposed. Cognitive information utilisation is a deliberate and highly selective process, with some information accepted and some rejected. It may be argued that the extent and nature of acceptance and rejection of information provided to the girls may be a product of the limited time given to them to establish and record what they know. While there was a time limit imposed on the data collection procedures, the girls said they were generally comfortable with the allocated times, and that there was sufficient time to think through the task and to adequately express their ideas. As discussed later, where time became a problem, some girls were able to identify their coping strategies. In a few instances, some more time was given to enable the girls to complete their writing.

There is some evidence in the study to suggest a number of factors played a key role in the selection process. While the study did not focus on why the initial knowledge prior to the exposures was the way it was, nor why some information was chosen and other information rejected, the written and verbal responses provided some suggestions for the basis of selection. Frames of reference (as discussed in Chapter 2.5) appear to play an important role in selection, and a number of these were identified by the girls.

Dervin, in her keynote address at the Information Seeking in Context Conference in Tampere, Finland in August 1996, highlighted the importance of understanding people's situational context as the most important variable in shaping people's information seeking and use behaviour. She argued that context is in people and people are in it, and that context is a label for a "site of struggle" in which people are reaching for a new kind of understanding. She claimed that a contextual view mandates a "a new way of being as scholar and researcher", particularly in terms of "mandating a walk toward complexity, toward ... digging deeper" (Dervin, 1996: 27). At the same conference, Allen urged that future research into people's information need, and understanding how they utilise information, could be guided by an

integrated understanding of how individual and situational variables affect information behaviour (Allen, 1996: 1).

The girls acknowledged that their own personal encounters and experiences with aspects of the many facts about heroin played a role in selecting information. These experiences provided a focus, a "trigger", a means for identifying related information and a hook for linking new information. For example, one girl provided information about the opium poppy as the botanical origin of heroin on the basis of the link "I am aware that there are poppy seeds on bread". Another experience, one that was identified by all the girls, related to Samuel Taylor Coleridge. All the girls picked up on the information about Coleridge using opium, whereas they did not select information about a number of other people mentioned, such as Elizabeth Barrett Browning and Thomas De Quincey. The girls made it clear that they were currently studying the life and poetry of Coleridge in their English classes, and prior to the information exposures, they indicated that they were not aware of Coleridge's association with heroin. In doing so, the information helped to make connections to, and elaborate, other existing knowledge structures.

Frames of reference in relation to immediate family were also important. One girl for instance identified that her grandmother was on morphine to relieve pain. This experience resulted in the construction of a small comparison substructure around that idea, based on her observations of her grandmother on medically prescribed morphine. One girl also identified that her brother was on heroin, and the effects of heroin she chose to record were connected to her brother.

All the girls selected information about the effect of heroin on driving, and the discussions indicated that this was important for them to know because they were at the age of either about to acquire learner driver permits, undertaking driving lessons, or had just obtained provisional driving licenses. Similarly, all girls incorporated information about the effect of heroin on pregnancy, explained by one girl in terms of "this is something I will be thinking about in the near future - you know, getting married and having kids". Their common interest in the effects of heroin on pregnancy and the newly born child seems to coincide with their life cycle - a time when young women are dating and

beginning to making decisions about relationships, marriage, and child raising. Immediacy in terms of aspects of their own age and life cycle appears to have played an important part in the selection process.

There was also some evidence to suggest that personal interest provided a basis for selecting and rejecting information. One girl said that she was only interested in Australian history, and paid little attention to the historical origins of heroin, commenting: "The early history doesn't interest me. I didn't take much interest because it is still too remote from me. I can remember quickly reading over the information on the Greeks and Romans, but didn't take any in. I looked quickly over the information until I found something I could relate too, like Coleridge, and the use of the drug in Australia". In some cases, information was selected to elaborate stories that had grabbed their attention, particularly through being told by family members, or through reading of fiction. These are found in comments of the girls such as "My mother told me stories of the side effects"; "We've discussed these things at home"; and "I read a book called 'Go ask Alice' which was a diary of a drug user". The girls also acknowledged that the media, particularly television, had shaped their knowledge of heroin, and that this was an important basis for selecting information. The girls made comments like: "I've seen images of thin, weak people with pale drawn faces and sunken, staring eyes". Another girl commented: "In some of the stories I've heard, such as the movie 'Pulp Fiction', and others that have stories of drug dealing, it never seemed to be a large amount". They linked new information to some of the ideas they had gained through the media.

Brookes asserted that "while information envelopes us" (Brookes, 1978: 21), people can take conscious note only of information which their sensory organs respond to, and that this information is only a fraction of the information which envelopes them. The girls in this study did not appear to note all that was put in front of them. They were not passive receptacles for information outputs, absorbing all information in toto. Brookes presented the human as "an active, highly selective combined data base and data bank plus dedicated computer all in his own right: an active 'black box' which is the result of a lifetime of information inputs and outputs interacting with a unique genetic inheritance and innate developmental program" (Brookes, 1980d: 251). The girls were highly selective in their choices, yet they also

demonstrated capacity to deal with the large number of propositions presented in the information. While the appropriateness of the amount of information had been established in the pilot study, this amount was quite considerable. There is evidence to suggest that when young people of this age are confronted with too much information to process at any one time, their information processing becomes dysfunctional. For example, in a study to investigate the effects of varying information loads on the choice behaviour of high school students when selecting books in a school library, Todd (1992) found that increasing information load increased students' level of confusion to some extent. In the conversations with the girls, there was no reporting of information overload; in other words, their ability to decide on which information to select and which to reject was not hampered by too much information.

Overall for these girls, the conscious noting of information appeared to be based on perceptions of personal relevance, dominant media influences, interest or influence derived from their personal goals, their learning context, current stage of life cycle, and/or current state of knowledge. Given that this study did not control for some of these frames of reference, the specific identification of these provides a fruitful avenue for further research. It raises questions such as how variations in personal experiences, existing knowledge and current stage of life cycle shape types of information utilisation.

Given these frames of reference appeared to be an important basis for active choice making, it is also worth noting that some ideas in the information exposures were resistant to being utilised. Wilson and Walsh (1995: 10) acknowledge that in addition to the notion of "attention", the idea of "cognitive avoidance" or turning attention away from that which is threatening, is an important cognitive drive in information seeking behaviour. Exploring the notion of cognitive avoidance represents a worthwhile extension of this study. While the actual content of the information was not the focus of the study, it however suggests that information will be utilised when it is judged by people to be relevant to where they are at their time of life, and to the dimensions of their specific situations.

6.2.2 Types of changes in knowledge structures

While it is acknowledged that the findings of this study were based on a small number of participants, it has established that there were some clear associations between the type of perceived effect and the changes to knowledge structures. These associations were apparent both between and within the girls. Each girl demonstrated these associations, although the number of each varied across the girls and across the different exposures.

The effect of *get a complete picture* was consistently associated with revised knowledge structures characterised as inclusive, elaborative and integrative. This type of cognitive information utilisation was reflected in changes to knowledge structures where set membership details were incorporated (inclusive), where property-, manner-, cause- and goal-oriented structures were developed (elaborative), and where separate structures were integrated more holistically (integrative).

The effect of *get a changed picture* was associated with an active and constructive process of building up a complete picture, making assessments of the picture, removing incorrect ideas, and replacing them in a reconstructive process with what was perceived to be more appropriate ideas. The model shown in Figure 36 presents *get a changed picture* as a process of construction, deconstruction and reconstruction, where knowledge structures are constantly made, challenged, destroyed, manipulated, and remade as information is encountered.

The effect of *get a clearer picture* was commonly associated with revised knowledge structures showing explanation and precision. These knowledge structures showed the insertion of ideas that provided how and why explanations, generating cause- and goal-oriented knowledge structures. Also characteristic of *get a clearer picture* were revised knowledge structures that appended information to add precision of detail through set membership.

In some instances, the effect of *get a verified picture* was not associated with any changes to knowledge structures. In other instances, this effect was associated with a number of distinctive revised knowledge structures. These

knowledge structures showed repetition of ideas to add emphasis, inclusion of set membership details, and reaffirmation of viewpoints.

The effect of *get a position in a picture* was also associated with a number of distinctive revised knowledge structures. Here, revised knowledge structures showed reaction, the presentation of personal conclusions, the formulation of predictions, and the development of knowledge structures perceived to be potentially useful in future situations where argument or viewpoint might be required.

As acknowledged in the literature review, limited investigations have been undertaken in regard to how people's knowledge structures change. The findings here support some of the investigations undertaken by Chi and associates [Chi & Koeske (1983); Gobbo and Chi (1986); and Chi, Hutchinson & Robin, (1989)]. Their studies focused on the way in which experts' and novices' representations of a small, simple and confined domain of knowledge could be structurally differentiated. They established two differing characteristics, that of the development of structures showing clear hierarchical organisation, and that of the integratedness of structures, referred to as coherence. Although this study did not focus on identifying and comparing novice and expert knowledge structures, some similar trends have been identified in the present study.

The present study did show the development of increasing hierarchy in the structures, particularly in relation to the specification of set membership details of a particular class. The building up of clear hierarchies of detail were associated with several perceived effects, that of *get a complete picture*, *get a clearer picture*, and *get a verified picture*. The girls associated hierarchical detail with expanding their knowledge, with clarifying aspects of their knowledge and with establishing and / or confirming the certainty of their knowledge. It is possible that in utilising information in these ways, the girls were developing their knowledge base from that of a novice to that of an expert. This aspect may offer a fruitful line of inquiry for future research.

The aspect of coherence of knowledge structures as identified in the studies by Chi and associates is also an important aspect in the present study. They elaborated coherence firstly in terms of local coherence, where local

substructures showed definite patterns of interlinkages, and global coherence, where the structure overall showed greater interrelatedness. The revised knowledge structures of the girls in this study showed increasing local coherence. Indeed, the ability to identify consistent patterns in the revised knowledge structures is suggestive of knowledge structures as locally coherent. This was particularly evident in the knowledge structures that were expanded by set membership details, and by building distinctive structures that were clearly coherent in their orientation - as property-, goal-, cause-, and manner-oriented structures.

The development of local coherence was also evident in knowledge structures associated with *get a clearer picture*, where coherence was established by providing often complex how and why explanations of existing ideas. The development of the girls' knowledge structures over the different exposures also showed increasing global coherence. There was evidence to suggest that they were able to integrate differentiated, even isolated knowledge structures into more integrated structures, thus building up greater coherence overall. This was illustrated in the *integrative* knowledge structures associated with *get a complete picture*, where there was evidence of the linking together of separate structures. It was also shown in the patterns illustrated in Table 8 where evidence was provided to show the trends from inclusive to elaborative to integrative changes, perhaps suggesting a development from increasing local coherence to increasing global coherence.

Brookes also asserted that "each of us has a private knowledge more or less coherent. ... Our knowledge structures continue to grow, to change their form, perhaps to become more rigid" (Brookes, 1978: 21). The girls' revised knowledge structures clearly demonstrated this coherence and growth. However, in this study, the issue of knowledge structures becoming more rigid is inconclusive. Brookes did not establish his meaning of "rigid". Some limited evidence of knowledge structures becoming more rigid, in the sense of unyielding or set, was shown in relation to *get a verified picture.* In a small number of cases some of the knowledge structures associated with this effect were characterised as defensive. In these changed structures, original position statements had been maintained, even though a change in the facts incorporated into the revised knowledge structures seemed to warrant a

change in position. In these cases, existing positions embedded in the knowledge structures could be seen to be somewhat rigid. Overall, knowledge structures were flexible and yielding, moving on rather than becoming fixed and inflexible.

Overall, the most predominant change to the girls' knowledge structures was through elaborating a more inclusive, general idea through set membership, providing more specific layers in the hierarchy of ideas. Knowledge structures that were changed to incorporate set membership were associated with a number of different types of cognitive information utilisation. Set membership changes were associated with *get a complete picture* (knowledge structures showed inclusive changes); *get a clearer picture* (knowledge structures showed changes of precision); *get a verified picture* (knowledge structures showed changes that confirmed through the provision of detail); and *get a position in a picture* (knowledge structures showed potential positioning by having a more extensive set of inclusive details). Specific facts seemed to have been important to the girls in constructing their revised knowledge structures, and these facts played different roles at different times in the utilisation process. The implication is not that young people should be immediately swamped with facts, in the hope that the provision of the specific facts might provide the needed pictures or cognitive effects. Rather, the implication is the need for information providers to focus on the desired cognitive effect, to understand how this effect is best met for each person, and to have available the detailed factual information if required by the individual to achieve the desired effect.

As indicated, some of the knowledge structures related to *get a verified picture* did not show any changes after the exposures to information. Brookes had claimed "some of the incoming information adds nothing new to what we already know; the corresponding parts of the structure are strengthened but not consciously" (Brookes, 1978: 22). This study showed that the exposures to information did strengthen their existing knowledge, in that they acknowledged they were able to confirm doubts, establish certainty of ideas, and strengthen their belief in particular ideas. Their perception of a verification effect indeed added nothing new to their existing knowledge, and there was no conscious indication of the structure being strengthened by some tangible indication of change. Doubts or uncertainties about existing

ideas appeared to exist as implicit notions rather than being consciously expressed in the written and verbal responses.

As far as can be determined, changes in knowledge structures associated with the different types of information utilisation have not been examined empirically by other researchers. To date, this study is unique, and in being so, it makes an important contribution not only to our understanding of cognitive information utilisation as an interactive change process, but also to our understanding of how knowledge structures change through exposures to information. In doing so, it contributes to our understanding of what is a fundamental assertion of information science, that information changes people's knowledge.

6.2.2.1 Discussion: types of changes in knowledge structures

On the basis of the findings that the perceived cognitive effects of exposure to information are associated with characteristic changes to people's knowledge structures, the study suggests that cognitive information utilisation imposes a purposeful organisation on knowledge. New information is not randomly attached to a knowledge structure, nor is it combined with existing knowledge in a disjointed and unstructured way, thus creating unorganised structures. Rather, different types of cognitive information utilisation create distinctive knowledge structures that are clearly organised, ordered and interrelated. Each of the types of information utilisation identified in this study brought about changes to knowledge structures that reflected purposeful utilisation of the information. For example, *get a complete picture* created changes in structure that showed inclusion, integration and elaboration of existing and new ideas. The information in each of these structures also showed purposeful organisation around properties, processes, goals, and outcomes. Similarly, *get a position in a picture* showed grouping of new and existing ideas that reflect reaction and prediction; and *get a verified picture* showed modified knowledge structures that reflected emphasis and defence. The units of knowledge in a revised knowledge structure collectively formed a coherent, integrated whole, and the structure itself manifested a particular type of information utilisation.

In a more general sense, the study suggests that the evolution of a person's body of knowledge about a particular topic is not a random acquisition of information, but is a directed and purposeful process toward making sense. One of the philosophical foundations of the sense-making theory and methodologies of Dervin and associates is the assumption of discontinuity, and the need for people to overcome discontinuities and find continuity, or sense. The idea that cognitive information utilisation imposes a purposeful organisation on the revised knowledge structures might be more broadly interpreted as a process of establishing continuity out of discontinuity, establishing order out of the disorder created by the exposures to information. Dervin asserts that "knowing is made and remade, reified and maintained, challenged and destroyed in communication" (Dervin, 1994: 377). Cognitive information utilisation is not the mental transfer of stable blocks of information from an external source to an internal source, rather, it is a processual interaction which constructs and produces effects; it is a making and a remaking, a destroying and a rebuilding. Brookes did not speak of continuity and discontinuity as such. However, he spoke of a knowledge structure as a "live information-seeking ... entity striving always to modify itself to be in dynamic equilibrium with the information it is receiving (Brookes, 1978: 22).

In utilising the information in the exposures to create the pictures they have identified, the girls showed ability to differentiate topic relatedness. They showed ability to analyse and sort information from the different exposures into topic groupings related to the task, and to cluster related ideas together. The revised knowledge structures give clear evidence of this. While the revised knowledge structures that they created were all different, even when aspects of the existing knowledge were similar, they were coherent in terms of topic relatedness. When questioning the girls, and later reading through their transcripts, the researcher was not left wondering why a particular idea was where it was, seemingly unrelated to its surrounding ideas. Coherence, equilibrium, continuity, order: the language and the perspectives vary; to Brookes, and indeed for the girls in this study, the "bits" find "their proper place" (Brookes, 1978: 23).

Another aspect about the girls' revised knowledge structures relates to the role of existing knowledge. It is evident in this study that cognitive information

utilisation is shaped by existing knowledge. This is a central notion of Brookes' Fundamental Equation where K[S] is assumed to be existing knowledge structures. The analyses of the revised knowledge structures showed that existing knowledge was an important basis for interpreting and integrating the various bits of information that were encountered and ultimately selected. For example, in the many instances of appending, the new information became a set membership extension, or a facet elaboration, or a qualification of the existing knowledge. The existing knowledge became a basis for information gathering, then for sorting, grouping, organising and integrating the acquired information so as to bring on the perceived effects of constructing, changing, clarifying, and verifying pictures, and to be able to reflect on them.

Each girl's initial knowledge was markedly different. Even though they were all exposed to the same information, and in the same order, the revised knowledge structures were also markedly different, yet each revised structure retained the stamp of the original knowledge structure, notwithstanding the many transformations that took place. The "personality", so to speak, of the initial knowledge structure was not lost, even though it underwent a number of transformations. The dimensions of the task also operated as an advance organiser for the girls, as documented in Chapter 3. These dimensions provided the structure for the initial organising of knowledge prior to the information exposures.

The role of existing knowledge identified in this study also reflects some of the ideas espoused by Pintrich, Marx, and Boyle (1993) and Ausubel (1963). Recent research on student cognition and knowledge change by Pintrich, Marx, and Boyle (1993) demonstrates that students' prior knowledge influences all aspects of their processing of information, from their perception of the cues in the environment, to their selective attention to these cues, to their processing and comprehension, to their thinking, and to their problem solving.

The role of existing knowledge has long been recognised in educational theory and practice, substantially shaped by the writings of Ausubel (1963; 1969). According to Ausubel's theory of learning, new knowledge is firmly anchored in what is already known. Existing knowledge provides

"anchors", that is, it is an advance organiser, and is used to develop conceptual bridges. In this study, the initial knowledge structures of the girls could be seen as advance organisers, providing the scaffolding for the selective integration of information. While the role of existing knowledge was not explicitly examined as a frame of reference, this might also be a future line of inquiry.

Ausubel also posited the notion of "subsumption", a process where the body of detailed knowledge and specific knowledge, the units of knowledge, are incorporated and lost to abstractions, generalisations, and more superordinate statements as knowledge grows. While there were some instances where the girls appeared to subsume information into higher levels of inclusiveness, there were also indicators that this was not an outcome of cognitive information utilisation. Given the emphasis of the study on stating what was known, the girls gave careful attention to stating the detail and repeating it, rather than subsuming it. The instances of subsumption appeared to be an artefact of the research design, and this was confirmed in some of the comments of the girls. For example, one girl said in reference to her written statements: "these are the main points, they help me keep track of all the detail". In this particular case she demonstrated an ability to create summaries, to synthesise information into generalisations or "main points" where the detail was removed. In discussing this comment, she also acknowledged that this was undertaken because of the time structure of the research process, rather than being an effect of the information exposure. Another girl used the heading "summary" and commented "I can still remember all the detail; it's easy to write down what you know this way". Both these comments suggested that the girls could "subsume" information, however, it was not attributed to information utilisation.

One final comment in relation to knowledge structures is about the girls themselves. The analysis of the knowledge structures clearly showed that the girls were not passive, robotic-like processors of information, merely absorbing information indiscriminately, replicating the information, and not knowing what was happening to them. The girls were active creators of knowledge. Their knowledge structures showed that they did not cite information from the exposures verbatim, rather, they manipulated ideas to construct their own understanding, putting their own personality on the ideas.

The girls appeared to be actively involved in the construction of knowledge rather than the reproduction of information, that is, plagiarism. This is consistent with Frederiksen's constructivist model of information processing (1975). While they had access to their own transcripts and the information provided successively with each exposure throughout the process, they did not appear to copy information for the sake of showing quantity of knowing. They did not know information simply because it could be copied on to their own records. They manipulated information selectively and creatively to develop their revised pictures.

6.2.3 Cognitive strategies

In this study, the focus on the cognitive strategies of appending, inserting and deleting has been as a means to an end, that is, an analytical tool in understanding the changes made to the knowledge structures. However, given their role in the process, some comments are warranted here. The identification of the three types of cognitive strategies is consistent with the conceptual literature discussed in Chapter 2.14.1. Concepts such as "expansion" and "addition" have been used to describe conceptually the cognitive change process of adding to a knowledge base. In this study, these theoretical constructs have been demonstrated empirically as "appending", a cognitive strategy to describe the joining of a new node by an arc to an existing node in the structure. This term was also used by Graesser (1981) to describe the same strategy. The theoretical literature refers to the process of making more complex transformations to a knowledge base with terms such as "revision" and "construction". This study provides empirical evidence for these transformations in terms of a generic change strategy called "inserting", where a new node or nodes and relations are inserted between existing nodes in the structure. Graesser (1981) also referred to this operationalisation as "inserting". The conceptual literature also refers to the process of removing ideas from a knowledge base, with terms such as "contraction", "deletion", and "erasure". In this study, these theoretical constructs have been demonstrated empirically as "deleting", a cognitive strategy to describe the removal of some node(s) in the structure.

In an exploration of conceptual graph structures related to comprehending passages of prose, Graesser (1981) posited five cognitive strategies,

described in Figure 4 (p. 82). These were "appending", "inserting", "pruning", "deleting plus restacking", and "reordering". An analysis of his examples suggests that "deleting plus restacking", and "reordering" are combinations of cognitive strategies that can be broken down into more generic strategies of deleting, appending and inserting. As far as can be determined, there does not appear to be any widespread empirical investigation of these cognitive strategies. However, in this study they have been shown to be a useful analytical tool in identifying changes to knowledge structures. In essence, the identification of these cognitive strategies makes an important contribution methodologically to developing procedures to examine changes to people's knowledge structures. They open a way forward to more systematically examining the whole arena of cognitive change by providing a useful analytical tool for identifying changes to knowledge structures. They also provide a useful means for testing the transformative - additive assumptions underpinning changed knowledge structures.

The analysis of the revised knowledge structures shows that particular cognitive strategies were associated with each of the perceived effects. Knowledge structures associated with *get a complete picture*, *get a verified picture*, and *get a position in a picture* were changed primarily by appending, although inserting played some role. The knowledge structures associated with *get a clearer picture* were primarily changed by inserting, and deleting played a fundamental role in changing knowledge structures related to *get a changed picture*.

6.2.3.1. Discussion: cognitive strategies

On the basis of these findings, this study suggests that cognitive information utilisation is at times transformative rather than merely additive. Brookes argued that the absorption of information into a knowledge structure was not simply an addition, where the new information was attached to existing knowledge without making any changes other than attachment to existing knowledge. There is some clear evidence in the study that information utilisation was merely an additive process, an addition, where a considerable amount of information was added by being appended to existing knowledge, and where the appended knowledge did not alter the existing knowledge structure. These appendings brought on quantitative changes in the sense

that the girls obviously appeared to know more after the exposures to information. The appendings, however, did not appear to take place indiscriminately, that is, the girls did not grab ideas and attach them anywhere for the sake of knowing more, and perhaps for impressing the researcher regarding the extent of their changed knowledge. The analysis of the changed knowledge structures showed that appendings and their links to existing knowledge made logical sense, and were for a purpose.

It could be interpreted from the analysis of the appendings that information utilisation is a simple, linear process. The girls' conceptual graph structures showed evidence that they created a large number of linear sequences for many of the concepts making up various dimensions of the drug heroin. These linear strings may be a product of limited knowledge initially about the drug heroin, or they may be an artefact of design of the research in that the procedure may not have explored all the inter-relationships between the ideas expressed by the girls. There was some indication that the former might be the case. By the end of the third information exposure, when their knowledge of the topic was greater, and more detailed, the girls were showing evidence of their ability to establish cross links, generating greater topic relatedness, and overall coherence to their knowledge. The linear strings may also have been a product of the nature of the written task. Writing, in continuous prose, naturally generates a linear sequence.

However, along with appendings, there were also a substantial number of insertings and deletings. These cognitive strategies brought on more complex adjustments to their knowledge structures. They showed that the girls manipulated and modified their existing knowledge to enable the inclusion and integration of new information in meaningful ways by making adjustments such as reorganising, repositioning, and regrouping ideas. They also made alterations when faced with conflicting information. While in many cases it was appropriate to append information, for example, to establish set membership, in other instances it was appropriate to make more complex transformations in order to provide an argument or explanation, or to establish the validity of an idea. The transformations, as shown by the revised knowledge structures, were consistently coherent and unified. The nature of these transformations also suggest that cognitive information utilisation is not just an additive process, nor is it a static process. Rather, as

Brookes suggested, knowledge, as "a structured entity, evolves by the accretion and integration of many increments of information" (Brookes, 1980d: 254), and that "the absorption of information into a knowledge structure may cause not simply an addition but some adjustment to the structure" (Brookes, 1980a: 131). The revised knowledge structures of the girls in this study indeed reflect this statement.

6.3 BROOKES AND THE FUNDAMENTAL EQUATION

And what of Brookes' Fundamental Equation of Information Science? The conceptual framework for this study was Brookes' equation $K[S] + \Delta I = K[S + \Delta S]$ (1980: 131). As already elaborated in Chapter 2, through this equation Brookes was suggesting that in the process of doing something with information, a person's existing knowledge structure K[S] is changed by an increment of information ΔI, and this modification has some effect, a changed knowledge structure $K[S + \Delta S]$ where ΔS indicates the effect of the modification. Brookes regarded his equation as a skeleton, seeing the major task of information science to "put flesh on its bones by analysing examples of knowledge structures and by observing how they respond to information received" (Brookes, 1975a: 117). This study, as one approach to putting "flesh on its bones" suggests that Brookes' equation holds true. In this study, the girls' existing knowledge structures were changed in a variety of ways by the information they selected, and the modifications were to some effect. In the process of utilising information, the girls were able to *get a complete picture, get a changed picture, get a clearer picture, get a verified picture,* and *get a position in a picture.* Information utilisation does bring about changes to knowledge structures.

As already stated, the perceived effects were clearly associated with distinctive patterns of changes to knowledge structures. The component of Brookes' equation that has been the central focus of this study, that of $K[S + \Delta S]$, conceptually reflects this unity of changed structure and effect. This study has empirically demonstrated this unity. Cognitive information utilisation, as a cognitive doing between the private knowledge of people and information, can be demonstrated as a consistent relationship between changed knowledge structures and perceived effects.

Brookes also acknowledged that the same information ΔI may have different effects on different knowledge structures. All the girls started out with the same information. Sometimes it was evident that they selected the same information ΔI from the exposures, such as the information about Coleridge, but how they utilised that information varied considerably. For one girl, the information about Coleridge enabled her to *get a complete picture* about the history of heroin; for another girl, it enabled her to *get a position in a picture* about the effect of the drug on people's creativity; and for another girl, it gave greater strength to her view of Coleridge as a creative poet. In this study, the process of utilising information, the process of constructing knowledge and the process of utilising that which is constructed were individual processes, shaped by existing pictures and person-in-context.

The study also provides insights into the nature of information and the nature of knowledge. What is information? and What is knowledge? were fundamental questions posed by Brookes. He recognised that the concepts of information and knowledge were central concepts in the emerging discourse of the cognitive viewpoint in information science. Information-as-movement is suggested as the emerging conception of information in this study. Information, that which is deliberately selected from what is available, and its utilisation, enables people to adapt and create pictures of their world. In the process of doing something cognitively with this information, people are able to move on, getting complete, changed, verified or clearer pictures, or getting positions in a picture. Information does have the potential to bring on cognitive change. This potential is not realised of itself. The active role of the person in selecting and attending to this information is an essential ingredient. Information is the stimulus that sets cognitive information utilisation in motion. Its outcome is a knowledge that is more complex, more accurate, more specific and more reflective.

And what of knowledge? From this study, knowledge is seen to be someone's constructed, organised picture about the world. It is cognitively constructed and structured. It is made up of many individual pictures, each in constant movement as information is integrated into it. Its nature is dynamic, ever-evolving, yet at the same time seeking to find an organised, ordered equilibrium. The Fundamental Equation, as an expression of cognitive information utilisation, is a holistic expression of this equilibrium.

6.4 EXPERIMENTAL DESIGN AND TRANSFERABILITY: SOME ISSUES

The purpose of this research has been to provide a richer understanding of concepts of cognitive information utilisation. While the question of generalisability has not been a major purpose of this research, the quasi-experimental design raises a number of related issues which may impact on the extent to which these findings can be transferred and applied to other contexts.

As stated in Chapter 3, a number of design features were built into the study to assist readers in judging the credibility of the findings, as well as in making judgements about their transferability. The research method is explicated in detail so the reader can judge whether it was adequate and makes sense; there is a full running record of data collection procedures and analytical approaches; and examples of raw data have been incorporated to demonstrate connections between the presented findings and the real world of the girls. Some issues related to these aspects that have emerged will now be considered.

The girls showed a high level of commitment to being involved in research. On appearances, they gave it their full attention and energy. They were informed of the purposes of the research and had agreed to participate. They had opportunity to ask questions to clear up any aspects of the research. It is likely that they approached the task with a committed goal of making sense of the information and integrating it into their existing knowledge. The question remains as to how the setting and design features may have impacted on the findings. In a real world not constrained by the artificialities of research designs, individual motivations of young people vary, and peer, parent and teacher interactions are acknowledged as shaping motivations, goals, and outcomes. This study has made assumptions about the girls' beliefs about their capacity to accomplish the task. Through the selection process, it assumed that the girls had positive self-efficacy beliefs, that is, positive individual beliefs about their performance capabilities in the particular subject domain, that they had the cognitive capabilities to accomplish the specific hypothetical task, and that they had a high level of confidence to do

the particular task. To a certain extent, the profile of the girls, and the criteria involved in their selection controlled for these frames of reference.

In this study, the hypothetical task and the knowledge elicitation and acquisition procedures controlled the goals, intentions, and purposes of the girls. The hypothetical task provided them with a framework for selecting information and organising their knowledge; there was a high level of engagement with the task and willingness to persist with the task. Unlike this study, in the everyday world of information seeking and gathering, people have some control over the choice of activities and how to do them; they guide and control their own activities.

This research was situated in a context of school learning. Even in this educational arena, with a current emphasis on individual learning, independent and lifelong learning and resource-based learning, young people are increasingly being given opportunities to decide on what they want to learn, how they want to learn, and how they will demonstrate their learning. They are being given increased freedom of choice in their information seeking activities, and how they will utilise this information.

In contrast, this research provided no choice in terms of the task, the information provided for the task, nor how the information would be presented. In the real world of the classroom, the completion of the hypothetical task is likely to require some active information seeking. In this study, the physical availability and intellectual accessibility of information were controlled, with the choice of information deliberately matched to level and ability of the girls. They expended no mental or physical effort in seeking it. It is likely that the whole cognitive effort expended by the girls was far less than what would have been expended normally. In reality, they may not be so motivated to seek out new information or discount relevant information that might contradict already established beliefs or knowledge structures. In the real environment of the classroom, tasks that are presented to young people in class may not be as structured procedurally or conceptually as they might be in an experimental setting. Learners often have to define the task for themselves; providing their own goals and structure, and undertake searching and recording their information without little assistance or guidance.

A study by Jones (1996) on perceptions of teachers and students in the research assignment process, a typical learning strategy that requires some information seeking, found that teachers assume that most students possess and are capable of using expert strategies when completing research assignments. However, the students indicated that they do not possess many expert strategies, and have developed a surface approach to many tasks that avoids dealing with the topic in the deep manner the teacher assumes. The study also found that while teachers assess and provide feedback on the qualities of the assignment product, they do not provide comment or help on the information processes that have been used to achieve this and do not instruct their students in developing these processes. Jones' study highlights some of the limitations of the current study when considering transferability of its findings, and raises the question of how the different types of cognitive information utilisation would be reflected in the real school experiences of these girls, rather than the constrained experience provided in the study.

In this study, the printed text providing the information to the girls was manipulated, contrived for this particular research. The text was crafted, with careful consideration given to readibility, use of technical language, overall logical flow and coherence of ideas. The suitability of the text was established in a pilot study, and as documented in Chapter 3, some changes were made. The exposures were also controlled by pre-determined fixed amounts of information to be provided. In reality, both of these conditions do not simulate the real world information environment. Here, information gathering takes place by choice, where people deliberately make choices about the format and nature of the sources, how much information, and when they want the information. The real world also involves passive information exposure, for example listening to news broadcasts on television, where the content is often not predictable.

What then of cognitive information utilisation beyond the immediate context of a school environment and not contextualised in a specific, controlled problem-solving situation? Savolainen's study (1995) of everyday life information seeking highlights the limited attention given to people's seeking and utilisation of information in everyday life. Savolainen asserts that most people seek after an internal coherence of everyday things because it gives

them better chances to plan their choices and act meaningfully, and this requires taking active care (Savolainen, 1995: 263). His study showed that the utilisation of various information sources and channels was determined by availability and accessibility of the source or the channel, ease of use, as well as the degree of motivation and personal courage to seek for assistance (Savolainen, 1995: 282). His study also suggests that successful problem solving is related to high rate of cognitive competence, systematic thinking, energetic seeking of information and optimistic stance to solvability of problems (Savolainen, 1995: 286). In essence, these were some of the frames of reference that were controlled in the present study. Taking these girls out of the formal research constraints imposed by the quasi-experiment raises the initial dilemma as to how their cognitive information utilisation might be observed, and what types would emerge.

There is also the question of an experimental design versus a naturalistic approach that situates the investigation into the real world. Dervin's sense-making methodologies may offer a fruitful approach in this regard, particularly the micro-moment time-line interview and the critical incident technique. This approach focuses on asking a respondent to select a problem situation which requires some attention, describing in detail the context, origin of the problem, phases of problem solving, and cognitive strategies in relation to the information gathered. Sense-making's questions focus on understanding the situation, the gap, and the helps or effects wanted. Questions in relation to exploring the effects or helps might be: What were you trying to do? How did you plan to use this? What did you want to be able to do? What kind of help / outcome did you want? How did the information help? What did the information enable you to do? Longitudinal studies with such interviews, diaries and other records might be useful in providing a detailed picture of how respondents' knowledge changes. There is the danger that such reconstructions may lack the specificity and precision that the present study was able to acquire, yet they are situated completely in the real world of the people involved.

It is ultimately up to the future researcher or decision maker to judge the credibility of this research and the transferability of its findings. It is also recognised that the characteristics of credibility, dependability and confirmability established in this study will not of themselves compel others to

accept the findings of the study. This study however makes a strong contribution to the developing knowledge base related to cognitive information utilisation and to the broader multidisciplinary area of cognitive information processing. It provides a set of constructs that illustrate the complexity of cognitive information utilisation, and a workable methodology for digging deeper. The set of constructs and the methodology provide a springboard for further investigating questions surrounding the transferability of the findings.

6.5 IMPLICATIONS

This section addresses some of the implications of this study. It discusses some implications for the practice of information provision, raises some methodological implications, and provides some directions for further research.

6.5.1 Implications for practice

Four potential practice applications emerge from this study. These relate to: database design for more effective retrieval of information; approaches for information providers for adding value to the information interview; enhancing instructional processes in formal education systems; and the provision of information in media publicity and public education programs.

6.5.1.1 Data base design

The findings provide an approach to the design of electronic information retrieval systems based on an understanding how people cognitively utilise information. Traditional electronic database systems are designed to be accessed through a range of document descriptors, such as descriptors describing content, author's name, type of publication, date, and intended audience. Despite design developments in the last decade that have taken user characteristics into account, identifying information most relevant to individuals is still considered problematic.

The types of cognitive information utilisation identified in this study provide an alternative set of categories of desired outcomes which could be built into

information systems as a central design feature. They provide an approach for allowing a person to enter the system, not just in terms of the content or document description, but also from the perspective of the cognitive effects that they might seek, such as: wanting facts, opinions and viewpoints, details, arguments, explanations, identifying misconceptions. For example, a user might desire to locate information about heroin that provides explanations *(get a clearer picture),* or position statements *(get a position in a picture)* or facts that elaborate their current understanding *(get a complete picture).* They may be able to profile their current level of knowledge in some way, and then link to documents which elaborate, or explain, or provide position statements as required by the person. In other words, the findings of the study suggest a design approach of matching user defined cognitive effects with portraits of particular resources, as well as potential multiple viewpoints related to cognitive effects. The incorporation of cognitive effects as a system design feature means that the user becomes a central focus in the design process, rather than an afterthought.

Computer technology is available today that enables the creation of hyperlinked databases which have linkages in multiple directions. The capability is there technologically to build links into systems related to content, cognitive styles, cognitive effects sought, user profiles, and information seeking styles. Current developments in technology give a mandate to invent and test alternatives to access. The outcome would be information retrieval systems that could facilitate the constructing of cognitive bridges, and thereby be more effective tools supporting individual meaning making. This would contribute to maximising the potential of the technology in terms of diversity of utility. One outcome that could be envisioned could be along the lines of Dervin's suggestion of an electronic advisory service (Dervin, 1989: 228). For example, in a library, the way in which a particular book has served a variety of cognitive purposes for past users could be recorded in an electronic readers advisory service, enabling the reader to call up materials which have helped those past users.

An immediate specific application is potentially in relation to the design and development of intelligent tutoring systems and independent learning packages using computer information technology. Their learning contexts

lend themselves readily to incorporating design features based on cognitive effects.

A number of user-centred benefits could potentially emerge from such designs. Obviously as suggestions they would need to be systematically verified. Such systems could contribute to enhanced browsing, grouping, connecting, interpreting, skimming and formulating; enhanced intellectual accessibility, item identification matched to need, precision, selectivity, and also time-saving and cost-savings on the part of the user. Increased discrimination, increased recall, and improved precision of research results could be tangible outcomes.

6.5.1.2 Information interview

A potentially useful application of the findings is in relation to the role of intermediaries in the information exchange process. A critical question is: what is the role of the information professional in fostering effective information utilisation? Traditionally information professionals have been involved in facilitating users' access to information, and have developed extensive reader education programs that focus on using catalogues, databases, locational aides, index cumulations, and classification schemes. The primary mechanism for this dialogue in many information agencies is the reference interview. The role of the information professional here is conceived in terms of matching people to specific resources, with questions primarily focusing on identifying content, and then matching content to specific sources. Traditionally, the questioning approach has focused on subjects, authors, keywords, titles and formats, that is, content or bibliographic description, and on expanding and narrowing details about these.

The types of information utilisation identified in this study provide a new way of looking at the form of the dialogue between the information user and the information professional. The approach gives attention to understanding the kinds of cognitive effects desired, for example, explanations about how and why, or a range of viewpoints or perspectives about a particular topic, or confirming a particular aspect. In other words, the interview would take a constructivist stance, seeking to ascertain how people want to move on

cognitively from where they are at with a particular content area, and seeking to establish the connections and links already existing between ideas. The outcome for the information professional would be a sharper understanding of the needs of the user from the user's perspective. This could play an important role in preventing premature diagnosis of the information need, as well as ensuring user satisfaction. Dervin and Dewdney's notion of neutral questioning (Dervin & Dewdney, 1986) reflects a similar approach. In contrast to this study's approach which focuses on uncovering internal, cognitive needs, their approach however focuses on uncovering the external, situational aspects that surround the need. This study contributes to a more holistic elaboration of Dervin & Dewdney's well-established approach.

A more specific application of the above relates to school students. Kuhlthau (1993), in her extensive studies of the information search process of users including secondary school students, has highlighted both the active sense-making role of individuals in "finding meaning that fits with what he or she already knows" and their view of information "as a way of learning and finding meaning or as a process of construction" (Kuhlthau, 1993: 3). Based on her studies, Kuhlthau conceptualised the information search process in terms of task initiation, topic selection, prefocus exploration, focus formulation, information collection and search closure (Kuhlthau, 1993: 43). These constructive processes collectively are about learners shaping their understanding rather than identifying content and finding the quick, right answer.

A significant finding by Kuhlthau in relation to this search process by both high school and college students was the low level of confidence they expressed in their early stages of their information seeking. Her findings highlight the need for intervention or mediation on the part of teachers and teacher-librarians when students embark on information seeking activities. Providing this intervention, along the lines of the cognitive effects identified in this study could help students form a more focused perspective, understand their search process needs in relation to the existing knowledge, and develop more meaningful searching and outcomes-related goals. Focusing on desired cognitive pictures may help reduce the uncertainty and its affective symptoms of anxiety and lack of confidence. Such intervention makes sound instructional sense, as it "involves fitting information with one

already knows and extending this knowledge to create new perspectives (Kuhlthau, 1993: 4).

6.5.1.3 Instructional design

As an extension of the above ideas, the findings of this study have implications for teachers in designing and carrying out classroom instruction. Understanding the types of information utilisation that take place shifts the focus of learning from the content, the products of learning, and finding the right answer to the question, to the process of learning, and particularly to understanding where individuals are at with their learning process. By understanding how cognitive change happens in relation to the stream of information that is provided to students, practising teachers can design better instruction to facilitate pictures. They can create opportunities for information utilisation to arise; they can help students more effectively understand their own constructive processes; and help students articulate how they interpret and find meaning in information. This puts emphasis on learning as a constructive process, and learners as people who understand their constructive process. Kuhlthau claims that "the process of construction incorporates a cycle of acting and reflecting, feeling and formulating, predicting and choosing, and interpreting and creating" (Kuhlthau, 1993: 31).

Enabling these types of information utilisation to take place also has implications for the nature of the classroom environment - more active process-oriented and cognitive effects-oriented questioning; more opportunities for students to reflect on their learning process; shaping of learning goals in terms of cognitive effects; and greater emphasis on evaluating the process of learning, rather than on making judgements about the mastery of content and the regurgitation of facts. It may also help teachers set more appropriate goals in learning, by identifying and making explicit the kinds of pictures they want to create in class.

6.5.1.4 Provision of information in media campaigns

This study also raises some implications for the provision of information about drugs, such as through government drug awareness services, media and school education campaigns and citizens groups. New information does

not have universal and constant applicability. The research provides an approach for individuals, departments or organisations in evaluating and compressing relevant information in order to provide groups with appropriate and meaningful information. It suggests that in the process of restructuring and repackaging information, the immediate needs, situations and cognitive effects sought can inform this consolidation process.

Often drug awareness campaigns and education programmes convey the idea that simply making the information available, sometimes with graphic portrayal of serious consequences of drug abuse, will convert the existing drug problems of young people into non-problems. They convey the idea that without any special effort on behalf of these young people, truth and positive personal and social action will prevail. Underpinning this is the assumption that the very existence of information presses it towards cognitive utilisation; that given information, cognitive change occurs. The study shows that no matter how compelling, or authoritative information might be in the minds of others, no matter how useful someone else might think the information is, these qualities do not guarantee its receptivity and utilisation by particular groups of people. The study also suggests that careful attention needs to be given to the selection and packaging of this information, ensuring that it is responsive to the cognitive needs and the person-in-context.

More specifically, the study suggests that matching choice of information to where adolescents and young adults are at in their personal and social experiences and their physiological development may mean that it is utilised more effectively and integrated more meaningfully into their existing knowledge. Targeting the provision of information to specific aspects of the immediate contexts and life stages of groups of people, rather than trying to cover all circumstances of large heterogeneous groups, may be a more productive step forward. For example, rather than providing media drug education campaigns based on general information, focusing on the provision of specific information related to specific dimensions of life cycle, for example pregnancy, or effect on driving, may be more productive.

There are also similar implications for the content of drug education programs made available in schools. These are often provided by

Government departments, and outside of the established curriculum. These often consist of detailed information packs, with associated learning activities. Schools are encouraged to integrate these programs into existing curriculums. Placing an emphasis on helping students to make sense, and understanding how cognitive change comes about in utilising information may mean a refocus in the provision of content from the transmission of a mass of facts considered "true", to a more careful, perhaps limited selection of content based on understanding the kinds of helps, utilities, or cognitive utilisations that students are seeking. This approach of matching choice of content to potential utilisations desired by people also implies the implementation of strategies to diagnose the specific utilisations sought by people.

According to Makkai & McAllister (1990), it is generally agreed that the best way to cope with drug abuse is through prevention, most notably via improved education and information dissemination. They acknowledge also that campaigns to reduce illicit drug use may actually increase it by stimulating interest and inquisitiveness about their effects through widespread publicity. This was actually suggested in the responses of some of the girls. Makkai & McAllister assert that before effective education and media campaigns can be designed and implemented, it is necessary to identify what is needed, as well as perceptions of how it is needed and how relevant it is to recipients. They conclude that the design and implementation of drug prevention programs must take into account the complex interactions between knowledge, information demands and information sources (Makkai & McAllister, 1990: 351). The present study provides a methodology for understanding these complex interactions in the context of provision of information to young people about drugs. The cognitive effects identified in this study provide a conceptual framework for understanding how, what and why drug information is needed by young people.

6.5.2 Methodological implications

Historically, a major difficulty with exploring cognitive information utilisation has been the methodological problem of peering into or reading people's minds, a problem identified specifically by Brookes. Brookes claimed that the "severest difficulty" is that "human cognitive processes are not accessible to

'public observation' at the level of detail required". He concluded that this was "an immense task, far beyond present contemplation and probably beyond our reach forever. ... But there is a long, long way to go before results applicable to the cognitive processes of individual users are likely to emerge" (Brookes, 1980d: 251). Despite his pessimism, he did suggest "experimental or observational knowledge structure and information inputs. ... We then have to observe what happens, measuring the effects as well as we can, at first in simple cases and then in more complex cases" (Brookes, 1975a: 48-49). This study has challenged Brookes' doubts and pessimism. It shows that such an endeavour is possible, at least in the situation established in this research. The quasi-experimental approach reported here does represent an important beginning, a simple case, and a sound basis for investigating more complex cases.

This study clearly provides a workable methodology for exploring Brookes' Fundamental Equation, and a starting point for refining more sophisticated methodologies. The equation is capable of being tested, critiqued and refined. This study has broken through some of the methodological barriers that have hampered progress in this area. The methodology developed is shown to be sensitive enough and detailed enough to allow new concepts and perspectives to emerge. Based on this methodology, a more indepth questioning approach may enable more detailed and refined constructs, as well as additional constructs to emerge. This however may also extend the time frame of the data collection process, with potentially negative consequences.

The procedures for data collection and analysis established in this study were shown to be workable. Notwithstanding, they were time consuming, and involved a considerable time commitment on the part of each participant. The processes of translating the acquired knowledge into conceptual graph structures, and undertaking the comparative analyses were also time consuming. There are substantial time and cost implications if the procedures are to involve a much larger number of participants, and it is likely that this would require a team of researchers.

Two assumptions underpinning this study were that the written and verbal responses were an adequate correspondence with the internal reality of the

girls; and that the girls were credible describers of their internal reality. The girls were able to articulate in specific and precise ways what the effects of the information exposure were; that is, what it enabled them to do cognitively. They seemed to be able to do this quite easily. They demonstrated a high level of introspection, an ability to stand back from what they were saying and writing about their knowledge of heroin and its research context, and to examine what happened to their knowing. They seemed to be able to do this without much prompting on the part of the researcher. They were also able to identify specific examples of their knowledge to illustrate their types of information utilisation. This too happened without a great deal of prompting on the part of the researcher.

The research process required the girls to undertake an intense process of reflecting on information and documenting what they knew. They were essentially required to go through a continuous process of rethinking their existing ideas and beliefs and comparing them with new ideas, and to make judgements about the plausibility and worth of new ideas, and make decisions as to whether to incorporate these new ideas into their existing knowledge structure. It is assumed that they utilised metacognitive strategies such as self-testing or self questioning to determine the credibility of existing ideas against the new information. Given the time frame of the data gathering, some substantial cognitive load appeared to be placed upon the girls. Yet the girls seemed to cope with this very well indeed. They did not express any negative feelings about the process, and remained cheerful and co-operative for the duration of the data collection procedures.

This study acknowledges that cognitive information utilisation takes effort and time. In order for the girls to utilise new information and for it to become an extension, elaboration, verification or modification of existing knowledge, a considerable time commitment and mental energy were required. The girls in this study agreed to make the time available, and throughout the research procedure appeared to maintain a high level of commitment to, and motivation and enthusiasm for the research task for the duration of the lengthy data collection time. Their sustained mental effort is acknowledged. The school has had an active public research profile over a number of years; the school's executive is very supportive of educational research being undertaken there, and the girls generally acknowledge that it is "cool" to be

involved in research. This also raises issues regarding the transferability of the research findings beyond the experimental conditions of this study.

One of the concerns expressed in the pilot study was the timing of the procedure so as to provide sufficient time for reflecting on the ideas, as well as recording knowing, and to avoid the dilemma of "get it done" versus "think it through". As already mentioned, there were some indicators that suggested time allocation may have been a problem during one or two of the exposures for some of the girls. However, the girls were able to undertake, and later articulate strategies to deal with these that in the view of the researcher did not compromise the research objectives or its integrity. For example, one girl commented on one particular section of her recorded knowledge: "I haven't changed what I know. It takes a long time to write down, that's why I'm mentioning it to you so you realise I still know all that I wrote before". After another exposure, she commented: "I still know all the other, and it hasn't changed with this information." Here the girl has acknowledged that she did not have enough time to repeat what she knew before and what was unchanged as a result of the new exposure to information, and saw the need to make this clear. Her statement showed evidence of her ability to reflect on the process, to establish strategies to deal with the problem, and in doing so, unknowingly make a contribution to the trustworthiness of the findings.

The methodology established in this study challenges traditional barriers to researching in this area. At a broader level, the approach challenges traditional research approaches to studying information utilisation, particularly from the perspective of information utilisation as interactive change process, and provides an alternative to them. The study of information utilisation in the past has been undertaken through survey and case study methods, with little use made of quasi-experimental and experimental designs. The quasi-experimental approach has been shown to be a worthwhile basis for establishing constructs in this area, a basis that can be further tested and elaborated by some of the traditional approaches. This study thus enriches the theoretical and methodological repertoire of studies on information utilisation.

6.5.3 Implications for future research

A number of key questions emerge out of this experimental study that can form the basis for future research. It is acknowledged that the limitations of study and experimental controls may have shaped the nature and number of the types of cognitive information utilisation. At the outset, the number of girls involved in the study was small, and begs the question of how the types of cognitive information utilisation would be similar or different if a larger group of girls had been involved in the study. Indeed, emerging from this study are questions such as: what other types of cognitive information utilisation exist other than those already identified in this study? Are these types universal? In this study, the experimental design controlled for a number of frames of reference. These included gender, written and verbal language fluency, academic performance, academic motivation, information seeking, the type, format and length of exposures to information, and information processing time. The study did not explore how these frames of reference interacted with one another, with the new information, existing knowledge and the task, to bring on the types of information utilisation identified in the study. Would the resultant types of information utilisation be similar, for example, if all the girls did not have high levels of English language fluency? Would there be the same effects if their general academic motivation was less? How does their interest stimulate depth of processing of the content? Evidence from educational research suggests that interest plays an important role in students' subject matter learning (Alexander, Kulikowich & Jetton, 1994). Is there a difference between transient, situation specific interest (like motivation in the context of this research, being interested because it is "cool" to be involved in research) versus long-term personal interest, such as wanting to help a sibling overcome the problem of heroin addiction? How do the types of cognitive information utilisation vary according to different age groups? Adults? Young children? This in turn raises the whole question of how competence develops and the need to address developmental issues from a holistic perspective of the person.

In this study, there were some indications to suggest that some types of information utilisation became necessary conditions for other types of information utilisation. For example, *get a complete picture* often became the basis for *get a changed picture*; *get a complete picture* and *get a clearer*

picture became the launching point for *get a position in a picture*. This study has concluded that cognitive information utilisation is an evolutionary process, constantly in motion, being shaped as the knowledge base changes, and changing as the knowledge base is shaped. This raises the question of how does cognitive information utilisation as a dynamic sequence change as it proceeds? Some longitudinal as well as cross - sectional investigations would help answer some of these questions, as well as using a larger group, to elaborate the interactions of the different exposures over time.

In the light of the types of cognitive information utilisation that took place and the nature of the changes to the girl's knowledge structures, a worthwhile extension of this study could be an analysis of the content, the "rightness" or "wrongness" of the newly created knowledge, the reproduction and modification of the content of the exposures, and how these are linked to existing knowledge and individual contexts. This, coupled with an understanding of the types of utilisation sought by groups of people, would make a major contribution to the choice of content and structuring of information exposures to ensure meaningful utilisation, particularly where the content itself is related to a potentially life-threatening issue such as drug abuse. This notion finds some support in other disciplines, for example, education. A recent review of educational literature by Alexander, Kulikowich & Jetton (1994) on the role of subject-matter knowledge and interest in the processing of linear and non linear texts suggests that careful evaluation of learners' knowledge and interests are more apt to result in gains in subject-matter knowledge. In addition, this review suggests that one's personal investment in the topic or domain stimulates depth of processing in the content and, thus, enhances subject matter learning. It also indicates that a person's long-term interest in the subject, rather than a transient interest is apt to have more consistent and positive effects on learning.

In this study, the group consisted entirely of adolescent girls. Does gender matter? Given the same experimental conditions, and employing the same age of boys, would the types of cognitive information utilisation be the same? There is considerable conflicting evidence about the similarities and differences of information seeking and utilisation patterns according to gender, and this may open up a potentially interesting line of inquiry.

A critical question is how does the presentation of the information shape the utilisation process? Do different formats of information matter? While printed text remains the principal means by which individuals acquire subject-matter knowledge, the emergence of electronic information delivered as multiple medias in the form of multimedia CD-Rom and the Internet is regarded as a major factor in shaping future access to information, and as a significant aspect of the learning process. These formats of information are proliferating in many public information agencies and school libraries at this time. Traditional text is a type of connected discourse where decisions relative to processing are left solely to the reader. Electronic information is in hypertext format, providing multiple non-linear pathways. The impact of these on information acquisition and information utilisation remain significant challenges for the profession - particularly as it impacts on the role of information agencies and public libraries in providing information. The use of linear / non-linear text situates people in different information environments, and raises the question of how this impact on someone's ability to acquire and utilise information. More specifically, are there different types of cognitive information utilisation associated with different kinds of information presentation?

Alexander, Kulikowich and Jetton (1994) have suggested that when people utilise information from a linear text environment, information processing has a more microprocessing orientation, where effort and interest centre on formulating inferences, distinguishing between important and non-important content, or identifying main ideas at the paragraph or passage level. They also have suggested that non-linear information brings about a more global level of processing - people focus on their ability to navigate through systems and how they access and combine resources, rather than on what they may be thinking or what interests them at word, sentence or paragraph level. How does this impact on how they utilise this information? A comparative study of a group of people working with electronic, hypertexed information or print paper-print information, and the types of cognitive information utilisation undertaken would be of value.

For the age group concerned, this study raises a number of information literacy implications. Considerable attention has been given in recent years to the development of young people as information literate students. The

ALA Presidential Committee Report suggests that to be information literate, a person must "be able to recognise when information is needed and have the ability to locate, evaluate and use effectively the needed information. ... They know how information is organised, how to find information, and how to use information in such a way that others can learn form them" (ALA, 1990: 1).

Information literacy is presented by Kirk, Poston-Anderson, and Yerbury (1991) as an holistic, interactive learning process that has to do with people confidently being able to solve their information needs. In the school environment, information literacy is fostered through the development of a range of intellectual skills centring on: defining the tasks for which information is needed; locating appropriate sources of information; making judgements about, selecting and recording relevant information; understanding and appreciating this information and being able to combine and organise it for best application; presenting the information learned in an appropriate way; and evaluating the outcomes in terms of task requirements and increases in knowledge. Embedded in these views of information literacy and its related skills are a number of concepts centring around information needs, information seeking behaviour, and people being able to do something with information, that is, information utilisation. The school that the girls in this study attended has given considerable attention to integrating an information literacy framework into its teaching and learning programs. It is likely that the girls in this study had received instruction in their year at the school in relation to these information handling skills. This raises the question whether these information skills have contributed to their ability to utilise the information in the various exposures. How would people without these information handling skills utilise the information? Would the types of information utilisation evident in this study be the same for these people?

The study also raises the question of the impact of low knowledge versus high knowledge, and the broader issue of novice versus expert knowledge. In this study, there was no attempt to establish the base measure of knowledge in terms of high, low, expert, or novice, and there was no comparison made of the extent or nature of the initial knowledge of the girls. This suggests a number of questions for further inquiry. Is there a difference in the types of information utilisation depending on the extent of the base measure of knowledge? Is a foundation of domain specific knowledge a

requisite to efficient and effective utilisation of knowledge, and what is the extent of this foundation? Is a certain amount of domain knowledge necessary for each type of information utilisation to take place? Also related to this issue are questions such as: What is the nature of the foundation knowledge base that can enable effective information utilisation? Do types of information utilisation vary according to differences in experts' / novices' domain knowledge?

Another important question relates to the domain knowledge itself. This study presented information taken from the school curriculum area of personal development and health, a curriculum situated in the biological sciences. It raises the question: Is there an effect of domain specific knowledge on types of information utilisation? Would the types of information utilisation be evident if the girls had worked with economics, or humanities, or geography, or music information, for instance? In other words, does cognitive information utilisation vary according to discipline? How do the types of information utilisation alter as the domain knowledge increases?

An interesting aspect of this study was why the second exposure gave the most indicators. This information was about the immediate and longterm effects of heroin for the individual. It was oriented to the individual, unlike the first exposure which was oriented to the origin and nature of the drug, and the third, which dealt with approaches to treatment of addiction. In a sense, the second exposure could be judged as more personally relevant to the girls, that is, it had more immediate relatability, whereas the information in the first and third exposures was somewhat removed from them. This raises questions of how disciplinary knowledge might be utilised differently if its personal relevance is explicated in any information provision.

One further issue relates to the order effect. The second exposure to information provided the most number of indicators of the perceived effects. As discussed in Chapter 5, a number of reasons have been posited for this. In order to test for order effect, future research might provide different participants with different starting points.

Further research questions relate to the issue of perceptions of the quality of the information contained in the information exposures. In this study, care

was taken to ensure that the information was accurate and reliable, that it represented "truth". The girls made the assumption that this was the case, and this was evident particularly in the discussions of their willingness to correct existing ideas that were wrong when compared with the information in the exposures. It may be that their willingness to utilise the information was based on this perception of the accuracy and reliability of the information. It raises the question of how cognitive information utilisation might proceed when the information that is made available is biased, or personal opinion, or of dubious quality, and particularly where there is limited basis for establishing the accuracy of the information. This is a particularly important issue, particularly in the light of the recent growth of the Internet as a means of information provision, and an important source of information. Books provide a number of in-built mechanisms for judging the quality of information - the publisher's blurb, details of the author's background, introduction, contents pages, index. However, these are often not available with information provided on the Internet.

In this study, judgements were made about the quantity of information to be provided to the girls, so as to control for confounding effects of information overload. The impact of information overload on the types of cognitive information utilisation is also an area for future investigation. In the context of everyday information seeking, the potential to be overloaded with information as the result of active information seeking is real. How does this impact on the types of cognitive information utilisation undertaken by people, and what other types might be demonstrated as coping mechanisms for information overload?

The impact of the knowledge acquisition process, and the context of knowledge acquisition also raises some important questions. In this study, written discourse and oral questioning were employed as approaches to acquisition of knowledge. Would the types of information utilisation be different if only free written discourse had been employed? Given that examinations are still a predominant approach to measuring students' acquisition of knowledge and learning, would a series of examinations have produced the same findings? If different acquisition procedures had been used, would the same types of information utilisation be identified? This also raises the question of the extent to which types of information utilisation are a

consequence of the structure of the task, for example, setting a task where there was no clear organisation structure for the acquisition of knowledge? Or where there was no task? The emerging emphasis in schools on resource-based and independent learning, where students set how they want to learn, what they want to learn, how they will measure their learning and how they will be assessed, is quite different to the prescribed task and prescribed procedures for presenting the knowledge. How does such freedom impact on the information utilisation process? In essence, are the types of information utilisation an artefact of the methods used to acquire the knowledge?

This study also poses questions related to the measurement of information. As stated in Chapter 1, this study has been informed by the shift from a system-oriented paradigm to a user-oriented paradigm in information science. The user-oriented paradigm emphasises "subjective" information (Dervin et al, 1986: 13), a conception of information as the personal, internal sense or meaning interpreted by the user. It could be said that the types of cognitive information identified in this study represent a measure of subjective information. This study thus can make a contribution to exploring this vexing issue.

6.6 CONCLUSION

This study presents an elaboration and extension of our knowledge of cognitive information utilisation. The findings on the different effects, as types of cognitive information utilisation and how they are associated with changed knowledge structures, suggest that cognitive information utilisation is a deliberate, constructive and active doing, a process of selectively integrating information into existing knowledge. For these girls, in the context of the aims and environment of the research, information made available through information exposures acts as an ingredient for the purposeful construction of new knowledge. In this constructive process, information is utilised for specific effects, and the stated effects are manifested in changes to their knowledge structures in distinct and consistent ways. The newly created knowledge is a holistic transformation of existing knowledge and information, integrated into a more meaningful whole, as shown in the characterisation of the changed knowledge structures. Cognitive information utilisation may

also be best understood as a dynamic process of knowledge creation toward a specified purpose. The changed knowledge structures evident in this study are highly organised and coherent rather than disconnected and incoherent. They suggest that cognitive information utilisation is purposive in nature.

For the girls in this study, the types of cognitive information utilisation identified are their way of making sense of the complex information-rich world they live in. They are the bridges between existing knowledge and new information. They are the means of owning new information and making it personal. Cognitive information utilisation is entirely subjective, where the complex interplay of context, situations, problems, knowledge, information, and opportunities gives a unique stamp to information utilisation for each person.

This study has moved beyond the primitive distinctions between conceptual utilisation that has characterised the study of information utilisation for many years. It makes a substantial contribution, both in terms of methodology and findings, to the development and elaboration of a cognitions-contingent model of information utilisation, identified as a major knowledge gap in the study of information utilisation.

This study also reaffirms the contribution made by Brookes to "find the grounds of information science" (Brookes, 1980a: 126). His understanding of the then emerging field of information science, its theoretical pursuits and research needs was clear and precise. His Fundamental Equation was a vision for the future, a frontier of inquiry for an emerging discipline. This study contributes to realising the vision of Brookes, and at the same time, highlights the lifetime of substantial and unrealised research challenges embodied in his Fundamental Equation.

APPENDICES

UNIVERSITY OF TECHNOLOGY SYDNEY

APPENDIX 1.1

Research Office

Director
Angeline Farmer

City campus
No. 1 Broadway
Broadway NSW 2
Australia

Postal address
PO Box 123
Broadway NSW 2
Australia

Tel (02) 330 1257
Fax (02) 330 1249

28 July, 1995

Professor Mairead Browne
Dean
Faculty of Humanities and Social Sciences
City Campus, UTS

Dear Mairead

Re: HREC 95/34 - BROWNE, Prof Mairead & EDWARDS, Ms Susan (for TODD, Mr Ross - PhD student) - "Information studies - a situational analysis"

Thank-you for your response to my letter of 29 June 1995. I have no hesitation in approving the application on the basis of the response, as authorised by the UTS Human Research Ethics Committee at its meeting of 13 June 1995. The approval number is UTS HREC 95/34A.

The NHMRC guidelines require us to obtain a report about the progress of the research, and in particular about any changes to the research which may have ethical implications. The attached report form must be completed at least annually, and at the end of the project (if it takes more than a year), or in the event of any changes to the research as referred to above, in which case the Research Ethics Officer should be contacted beforehand.

Please complete the attached form at the appropriate time and return to Susanna Davis, Research Ethics Officer, Research Office, Broadway. In the meantime, if you have any queries please do not hesitate to contact either Susanna or myself.

Yours sincerely,

Associate Professor Ashley Craig
Chair
UTS Human Research Ethics Committee

Campuses
Balmain
City
Kuring-gai
St Leonards

MARIST SISTERS' COLLEGE

The *Good News* in Education

APPENDIX 1.2

17th May 1995

Research Ethics Officer
Ms Susanna Davis
The Human Research Ethics Committee
University of Technology, Sydney
P O Box 123
BROADWAY NSW 2007

Dear Ms Davis

Mr Ross Todd has recently sought approval to involve some students from Year 12 at Marist Sisters' College as part of his PhD research.

I have discussed at considerable length with Mr Todd the specific requirements of his research, and the specific nature of the research to be undertaken, and what it will involve for all the students who participate. I have also reviewed the application that he has submitted for ethics clearance, including the supporting documentation that describes in more detail this research. The procedures that Mr Todd has set in place to ensure individual and parental consent, confidentiality, and the quality controls on the nature of the information to be provided to each student as part of the research, seem appropriate, and conform to the requirements for any one seeking to undertake research at Marist Sisters' College.

I am happy for Mr Todd to proceed with his research at Marist Sisters' College.

Yours faithfully,

Ms Elizabeth Lamb
Acting Principal

Tel. +61 2 330 1990
Fax +61 2 330 1551

APPENDIX 1.3

Ross J Todd
Department of Information Studies

Telephone: (02) 330 2722

Date:

I, ..., agree to participate in the research project "Information Utilisation - A Situational Analysis" being conducted by Ross Todd, of the University of Technology, Sydney.

I understand that the purpose of this study is to find out what I know about a specified curriculum topic, and how what I know changes when I am provided with new information.

I understand that my participation in this research will involve up to four hours of my time, and that there are no other risks or safety issues involved. I understand that I will not be asked to reveal any information I do not wish to reveal.

I am aware that I am at liberty to contact Ross Todd at the above address or telephone number, or his supervisor, Professor Mairéad Browne, if have any concerns about the research. I also understand that I am free to withdraw my participation from this research project at any time I wish without giving a reason.

I agree that Ross Todd has answered all my questions fully and clearly.

I agree that the research data gathered from this project may be published in a form that does not identify me in any way.

..../...../.....
Signed by student

..../...../.....
Witnessed by parent / guardian

Transport arrangements required: .....

Note
This study has been approved by the University of Technology, Sydney, Human Research Ethics Committee. If you have any complaints or reservations about any aspect of your participation in this research you may contact the Ethics Committee through the Research Ethics Officer, Ms Susanna Davis (ph: 330 1279). Any complaint you make will be treated in confidence and investigated fully and you will be informed of the outcome.

Ross Todd

Fax +61 2 330 1551

University of Technology, Sydney

APPENDIX 1.4

INFORMATION SHEET FOR PARTICIPANTS AND PARENTS / GUARDIANS

This research, part of my PhD studies at the University of Technology, Sydney, is exploring how young people take in new information, and how that new information shapes their thinking. Essentially this is what happens in schools every day as students are constantly provided with new information in the classroom.

However, little is known about what mental processes young people apply to this new information, and understanding this will be another small step forward in working out how students learn best, and how they can get the most out of information they face at school.

In this study, the procedure for each participant is quite simple. Participants will be asked to write down what they know about a particular topic studied at HSC level. This procedure will be repeated for each participant several times after each exposure to new information. Following each writing activity, students will be interviewed individually to clarify their written responses. The questions will be in the form of explaining "what, when, where, why, how", and are designed to elaborate on the written responses. These will vary according to the individual written responses. Typical questions are likely to be" "What do you mean by ...", "Why do you say ....", "What happens when...". The information students provided to students will be in print form, is information approved for use by the school, and is information readily available in the school's library.

This is the extent of the involvement for each participant. The written responses will be recorded anonymously. The written responses will then be subjected to a complex analytical technique by the researcher. This will not involve the students in any way.

The study will take place at Marist Sisters' College at the time and date indicated below. Students will be fully supervised by Miss Lamb, Acting Principal, and myself. Miss lamb will ensure that all participants are safely transported home. Please indicate if you would like the school to make these transport arrangements. Refreshments will be provided for participants throughout the process.

This research has been approved by Miss Elizabeth Lamb, Acting principal at Marist Sisters' College. I am happy to address any questions or concerns that you might have.

Ross Todd

DATE OF SESSION:

TIME:

APPENDIX 2.1

1.

Heroin is one of the opiates - a group of drugs derived from opium, a gummy resin obtained from the unripe seeds-pods of the poppy. It dates back more than 4000 years before Christ, and few drugs can claim a more fascinating and exciting history. In ancient times, as in the 1980's, opium and the drugs obtained from it were surrounded in myth and fantasy.

The opium poppy grows best in hot dry climates and produces the resin for seven to ten days of its twelve-month life. The plant grows to a height of 1 metre or more and has large, loose-petalled flowers about 10-12 cm in diameter. The flowers can be red, pink, purple or white. The resin called opium is produced in the few days after the petals drop and before the seed -pod matures.

The ancient Egyptians and Sumerians discovered the efficiency of opium as a pain-killer and later began to use the opiates (chemicals derived from the opium) for social purposes. Even in those early days its ability to relieve anxiety was recognised.

The drug has featured in ancient classical literature. Homer, Virgil and Ovid all refer to it, and it plays a part in Greek and roman mythology and Chinese legend. In the Arabian countries where the Koran forbade the use of alcohol it achieved remarkable popularity as the foremost recreational drug. Throughout European history opium has appeared in medical and social use, invariably surrounded by stories of miraculous cures.

In sixteenth-century Europe Paracelsus, a successful and innovative man of medicine who used opium extensively in his treatments, produced a new potion called laudanum. It is believed that Paracelsus's laudanum contained opium and it was as a result of his work that a new laudanum compound was produced in the seventeenth century in England by Dr. Thomas Sydenham. This new preparation gained in popularity and was used for almost every ailment imaginable. It was followed by Dover's Powder, invented by Thomas Dover, a student of Sydenham. A combination of opium, ipecac, licorice, saltpetre and tartar, Dover's Powder was incredibly potent and proved amazingly effective in the relief of pain.

Not long after this the use of opium assumed another dimension. It found favour with many noted writers and artists who discovered that opium greatly enhanced their perception of the world and their creativity. Among them were Samuel Taylor Coleridge, Elizabeth Barrett Browning and Thomas De Quincey.

In the eighteenth century opium was outlawed in China and a profitable smuggling trade was established. The British profits from smuggling opium were so great that they were able to finance all their tea imports from China. This was the setting of the Opium Wars, a lengthy and complex situation in which Britain went to war to be able to continue to pour opium from India into China. Despite considerable moral protest

it was not until 1913 that Bills were finally passed in the British Parliament to end the opium trade.

It was around 1800 that a German scientist, Frederich Serturner, managed to isolate the active ingredient in opium and opened the door for more advanced chemistry. The active agent was named morphine, after Morpheus, the god of dreams. By the 1830's people began to realise the value of morphine and it was hailed as a wonder drug. An injection of morphine was found to bring relief from even the most intense pain and seemingly without any harmful side-effects. During the American Civil War doctors used it freely to treat casualties. Many patent medicines containing morphine were freely available and used for both adults and children. At that time no attention was paid to the problems of addiction. Although the drug was available in the form of medicine, opium smoking was not much indulged in in Britain, the USA or Australia.

An addiction problem did develop, however, and was centred in England toward the end of the nineteenth century. In the Fenland area of East Anglia the opium poppy flourished and many people adopted the habit of taking opium and opium tablets. The main users were the middle-aged country women and the gangs of workers engaged in draining the fens. The medical profession paid the subject little attention, thinking the problems created by alcohol to be far worse than those of opium.

Towards the end of the century people in Britain, America and Australia were comparatively free to smoke opium and dose themselves with laudanum and morphine. It was around this time that the problems of addiction began to attract more interest from the medical profession.

In 1898 a new 'safe' drug was produced from morphine. Like morphine before it, it was hailed as a wonder drug - a 'hero' drug which would solve the problems of addiction to opium and morphine, while being itself non-addictive. That drug was heroin.

During the early part of the twentieth century the use of heroin spread rapidly. The effects were even more pleasing than those of opium or morphine. As criminal interests began to produce the drug for sale, the supplies increased. Then and only then was it discovered that heroin is almost three times as powerful as morphine and just as addictive.

By 1914 the use of heroin was sufficiently disturbing for US authorities to impose legal controls on its distribution by means of the Harrison Act. This required addicts to obtain their supplies from registered doctors and a register of supply to be maintained.

In nineteenth-century Australia opium smoking was largely confined to Chinese working in the goldfields, and although there are records of occasional use among

Aborigines the habit was not widespread. Patent medicines containing opium were popular but there were apparently only rear cases of addiction. Most attention was centred on alcoholism, which constituted a problem of much greater proportions and for which morphine was suggested as a cure.

It was not until the 1925 Poisons Act that restrictions were placed on morphine, heroin and cocaine, making them available only to members of the medical profession, nurses, dentists and pharmacists. Since that time Australia seemed to have been comparatively free of opiates until the mid-1960's and early 1970's.

The 1960's saw a period of great affluence in Australia; a time when young people, hooked on the concept of passive entertainment, adopted many American ideals via the broadcast media. There was at that time a feeling among the young of opposition to the establishment and hostility towards the ideas of authority and materialism. In contrast to the preceding years, work was becoming harder to find and drugs were becoming easier. Marijuana and LSD, increasing in use in the USA, attracted much media attention in Australia and seeded the beginnings of a demand.

At this time huge numbers of US servicemen arrived in Australia on leave from duty in South-East Asia. It has been estimated that 15 per cent of servicemen were heroin addicts by that time; many more just brought the drug with them. The illegal drug problem was in its infancy in Australia and it escalated with the arrival of the US troops.

For the American soldiers in Vietnam, heroin was cheap and easy to obtain and the supplies were 95 per cent pure. Young, inexperienced soldiers were thrown into a terrifying and hostile environment. Thousands of miles from home, daily facing the possibility of their own death or mutilation and the reality of death and massacre all around them, they proved a ready market for heroin dealers. Heroin offered them a chance to escape from the horrific reality into a dream world without pain and fear. It is hardly surprising that many became addicted to the drug. To young Americans and Australians unlike the indigenous populations of South-East Asia, heroin was a novelty. These young people had no background of heroin in their culture and therefore no cultural resistance to it. Just as the introduction of alcohol wreaked havoc among Australian aborigines, heroin invaded the lives of young Australians.

With the departure of the Americans from Vietnam the South-East Asian producers lost a huge market. At about the same time there was a major clamp-down on heroin use in the Philippines under President Marcos. Until then heroin had been rife throughout the islands, even in the primary schools. Marcos's clamp-down meant another lost market and the Asian syndicates looked around for new outlets. Australia was ready and waiting.

The social climate was right; there was already a small existing drug culture in marijuana, heroin and LSD. Young people were beginning to look around for more chemical solutions to life's problems. Australia's extensive coastline created tremendous policing problems, and there was a considerable criminal network which could be used to distribute the drugs.

In the 1960's the advent of marijuana had received tremendous attention and the media gave it the full 'drug-problem' treatment. The situation had been over dramatised and by the early 1970's marijuana appeared to be comparatively harmless. The press and the professionals had cried wolf too often, and when the wolf really appeared at the door only sheep's clothing was visible. Both the media and the professionals had lost some authority with the young, who were not prepared to listen this time to their shock-horror drug stories. The drug problem began to rebound on those who had first heralded its arrival, and it was the young who would bear the consequences. Australia was a sitting target for the heroin traffic.

The problem of heroin in Australia today is a complex one. Importation and distribution of the drug is controlled by organised criminal syndicates with international connections. The web of criminal intrigue continues to defeat law enforcement agencies; they seem to plug one hole only to find that another has opened.

Sadly heroin is largely a problem for young people - young people with problems, who lack the experience to deal with them and to withstand the onslaught of a powerful criminal network. But heroin presents us with a paradox: the drug itself, although it has dramatic effects for the individual and is a powerful and dangerous drug, is in fact less harmful to health than many others, including alcohol. The very status of heroin rather than the drug itself is largely responsible for the extent of the problem.

Illegal trade has led unscrupulous suppliers to 'cut' (i.e mix) the heroin they sell with other substances in pursuit of greater profits. Sometimes they use other dangerous drugs such as amphetamines, barbiturates or cocaine, but more often it is inactive substances such as talcum or baking powder, starch or highly refined sugars. When heroin is bought on the streets there is no way of telling what it contains and it is often as little as 5 per cent heroin. Because it is weakened by cutting, the user needs larger supplies. The subterranean lifestyle of heroin creates its own problems: infection from unsterilised needles, the use of other drugs when heroin is in short supply, poor diet and unhealthy living. All indicate that the poor health of heroin users relates more to the attitudes, personality and lifestyle of the addict than to the drug itself.

Heroin is a prohibited drug in Australia. That means that it is against the law to possess, manufacture, supply import or trade heroin (or any other illegal opioid). The

law has very harsh penalties for these offences - in NSW these include fines between $2,000 and $5,000, and/or a term of imprisonment between 2 and 20 years. The severity of the penalty given will vary accordingly to the quantity of the drug involved - the bigger the amount, the bigger the penalty.

Many overseas countries have much more severe penalties - including the death penalty - for people who break their drug laws. Anyone who is convicted on a drug charge then has a criminal record. This can cause many other problems in life - from getting a job or a credit card to getting a visa to travel overseas.

Because heroin is an illegal drug in Australia, it is difficult to estimate just how many people do use it regularly. But there have been some surveys done which suggest that between 10,000 and 20,000 people may be using heroin regularly in NSW at any one time. These figures are usually based on statistics for arrests and convictions for heroin use, and on figures for admission to hospitals and rehabilitation centres.

While the mere existence of laws has kept many potential users at bay, legislation has also created its own problems. Laws have done little to reduce heroin problems because, like drugs themselves, drug laws merely deal with the symptoms and do nothing to address the underlying issues of drug taking. Heroin users have become victims of a law which allows users of dangerous legal substances to use their drugs freely. The heroin user has to battle not only with dependence but with the law and society. This is true of all illegal drugs but heroin alone has spawned the subcultures surrounding its own unique lifestyle, subcultures unmatched by those of any other drug.

2.

Heroin is a fine white powder with a bitter taste. In appearance it resembles talcum or baking powder and similar products, which makes it easy for dealers to adulterate the drug. Some users sniff the powder but the predominant method of use is by injection. The injection can be into a muscle, or just below the skin ('skin popping') or 'mainlining', which involves injecting the drug directly into a vein. First the powdered heroin has to be converted to liquid, and this is usually done by dissolving it in a little water which is heated in a teaspoon over a match or candle flame.

Most research suggests that if people are given regular intravenous injections of pure heroin or other opiates, under aseptic conditions, there is very little physical damage to any organs of the body. Researchers seem to agree that in terms of physical damage cigarette smoking is far more hazardous than regular opiate use. Nor have opiates been found to cause mental illness.

At first, heroin briefly acts on the brain so that the user feels a stimulating 'rush'; then the drug depresses the central nervous system, so that the person feels hardly any pain, hunger or sexual urges. Some of the immediate effects are relief of pain and feeling of well-being. With a moderately high dose, the person feels warm, drowsy, and dry-mouthed and breathing becomes shallow. This is an effect which can create problems for those who suffer from conditions such as bronchitis, emphysema and asthma. With a large dose, the person's breathing becomes even more depressed, the pupils narrow to pin-points and the skin becomes cold. Large doses can depress breathing and other central nervous system activity enough for a person to slip into a coma and to die.

Most drugs can affect an unborn child. Heroin and other opioids do cross the placenta, and the unborn baby will become dependent on the drug. These babies can suffer withdrawal when they are born and separated from the mother's blood supply which contains the drug. These babies are also often underdeveloped and suffer from many infections. They may even be stillborn or die in the first few days. The poor health of these babies is linked to the poor health and nutrition of their mothers. These are common effects of long term heroin use. Women who are dependent on heroin often experience many health and social problems during pregnancy and childbirth. There are an increasing number of babies being born to HIV infected mothers who are heroin users. Many of these babies will also be infected and will eventually develop AIDS.

The major problem of short term use of any opioid is to do with the way it is used, especially use by injection. Opioids used hygienically and in pure form are not especially toxic to the body and appear to cause little damage to the user's body organs and tissues. Under medical supervision, short-term use of opioids should not produce problems. For example, many people have been given pethidine for two or three days after an operation and have not had any health problems because of the use

of the drug. However, anyone who uses an opioid drug like heroin for more than a few days is very likely to become dependent on the drug.

But illicit use of drugs like heroin often leads over time to many complicated health problems. These problems include hepatitis, abscesses, tetanus, pneumonia, heart, chest and bronchial problems, collapsed veins, chronic constipation, and brain damage. Users may also experience loss of appetite, impotence (in men) and infertility (in women). It is also common practice amongst heroin users to share needles and syringes. This greatly increases their risk of contracting either Hepatitis or HIV.

Street heroin is usually mixed with other substances which can be dangerous to the user's health. Because of these mixtures, it is also difficult for the user to know the strength of street heroin or other illegally obtained drugs. This can often lead to accidental overdose or death. Because of the high cost of street heroin, users often spend less on other things like housing and food. Combined with reduced appetite, this can lead to malnutrition, disruption of menstrual cycles and susceptibility to infections.

Heroin interferes with a person's motor and co-ordination skills, vision, speed of reaction, and perceptions of sounds, time and space. So it reduces a person's ability to perform complicated tasks, like driving a motor vehicle for example. It also interferes with thinking and decision making processes. It is an offence in NSW for anyone to drive while under the influence of any drugs, including heroin. Breaking this law carries heavy penalties including disqualification, fines and even imprisonment. Any person who is arrested for a driving offence and then found to be affected by, or in possession of, heroin is then likely to be charged with a drug offence as well.

The main health problem of continued opioid use is the development of tolerance and dependence, which result in withdrawal symptoms when use is cut down or stopped altogether. With prolonged use, tolerance is built up and the user requires larger and more frequent doses. With tolerance comes psychological dependence. When the effects of heroin are discussed, crime and violence are usually on the agenda but in fact the physical and mental state induced by opiates is non-violent. For the four to eight hours during which the effects of the drug are felt, the user is calm; mental and physical action are slow and the user is at peace with the world. Heroin addicts who are given the unadulterated drug in quantities sufficient to meet their needs exhibit no signs of violence or aggression. It is the heroin lifestyle, the illegality of the addiction, the adulteration and the cost of the drug which trigger acts of violence.

Contrary to popular belief the occasional use of heroin does not always lead to addiction. People who have been given the drug under experimental conditions do not report a craving for it. The 'one shot and you're hooked' theory is generally believed but it takes a period of three or four weeks of regular use before a physical addiction develops. Physical withdrawal from heroin is similar to a bout of flu - aching limbs, tremors, chills, sweating and vomiting. In addition there is discomfort as the

characteristic constipation wears off, producing painful bowel movements. All are nasty unpleasant symptoms but none of them are beyond the endurance threshold of a person who is otherwise in good emotional and physical health.

It is the psychological dependency on heroin which adds a dimension of horror to withdrawal, and the prospect of being without the drug which makes the process so frightening. With this knowledge it is sometimes difficult to understand why heroin users who express the desire to get off the drug don't just accept that they must endure a few days' discomfort in order to make the break. The answer lies in the user's relationship with the drug and his reasons for taking it.

Wherever we look we can see evidence of the fact that people use drugs to cope with unpleasant feelings of fear, anxiety, tension, boredom, insecurity, powerlessness and, especially, low self-esteem. We all experience these feelings at some time and in some degree, and our environment can seem hostile and threatening.

Young people perceive hostility in their environment, suffering all these feelings. Adolescence is a time of great stress and this stress often continues into early adulthood when people must take major decisions about their lives and identities. Growing up in an atmosphere where the use of mood-altering drugs is the norm, chemicals inevitably appear to be the ideal solution. Heroin users fall largely into the 18-35 age group. Young people encounter heroin at a time when they face all the problems of growing to maturity. Far from solving these problems, the heroin habit aggravates and prolongs them by delaying the maturing of personality.

A very good example of the way in which stress and negative feelings can lead to drug abuse can been seen in the experience of the soldiers and service personnel stationed in Vietnam. As many as 15 per cent actually became addicted to heroin. American authorities anticipated major problems when the troops came home. Once removed from that hostile, stressful environment, however, the vast majority of addicted servicemen were able to stop using heroin. Only a very small number remained dependent once restored to their home environment. Clearly the situation of the soldiers was the prime factor in their use of the drug. War may seem an extreme example but to many young people the world in its present 'peaceful' state can seem equally hostile and threatening.

Most people who try heroin are introduced to it by friends or acquaintances. Most try it out of curiosity, the need to conform or the fear of being ridiculed. Because the use of heroin exists so much in its own particular subcultures the non-user is excluded to a far greater extent than, for example, a non-smoker or non-drinker in a drinking and smoking peer group. Heroin is a way of life which demands total commitment and non-users are, of necessity, excluded from its rituals. Some heroin dependents do admit to having made a conscious decision to use heroin because they perceived it as a means of escape from life's problems. For many involvement with the subculture and the sense of identity which this creates become of prime importance. The drug melts away the fears and anxieties; the subculture provides security, purpose, occupation and a sense of identity.

The heroin lifestyle is dictated by the status of the drug and it is difficult for those outside to understand the energy and commitment required to maintain a heroin habit. We often see newspaper reports in which heroin addicts are prosecuted for offences committed in an attempt to obtain money. We read of an addict's habit costing $200, $500 or even $1000 a week. Most of us cannot conceive what that means in real terms; while we gasp in dismay at the sums involved, we rarely consider what it means for the individual.

A person who is dependent on heroin is involved with that dependency one hundred per cent of the time. Each day is a constant round of efforts to get money to buy more heroin, to find a supplier, then a place to administer the drug. For a few brief hours there is peace, and then the hunt is on again. Is there someone who will lend money or share their supply? Where is the friend who owes a favour, where will the next shot come from? Will it be found in time? To what lengths must they go to obtain it? There are always people to see, places to go, plans to make, essential things to be done in order to feed the addiction. The people in the heroin subculture all have the same purpose and involvement. There is the strength of shared experience, a feeling of belonging to some larger group, of being accepted. This commitment and involvement meets many of the individual's psychological needs. In the thick of it, managing and coping with something, organising, planning, pursuing and even achieving means involvement and purpose. And there is another dimension: identity. The user knows who she or he is - a junkie - and is a part of all that goes with being a junkie. Chaotic though it may seem to outsiders, there is some sort of structure, some expected form of behaviour, a pattern to follow. No more battles to establish a sense of identify; the role is absolutely clear, the structure clearly defined. For many it is the first real experience of knowing who they are and where they are going. This is the magic of heroin, just as much as the euphoric effect of the drug.

Outsiders often believe that heroin users lead a life of crime and sexual promiscuity. In fact crime is only incidental and a lowered sex-drive, combined with the energy and time spent in getting the drug, make sexual promiscuity something of a myth. But while the drug and its attendant lifestyle fill urgent needs, there are many other problems.

The threat of the law is ever present, as is the possibility of running out of heroin. Because the drug is administered in non-sterile conditions, in toilets, bush shelters, derelict buildings or even back home in the bathroom, the risk of infection is enormous. Illnesses and infections are neglected in the pursuit of more heroin and the fear of fronting up to a doctor. All this is aggravated by a tendency to abuse other drugs. When heroin is in short supply other drugs are used - alcohol, cannabis, amphetamines, barbiturates, tranquillisers - some of which may already have been take in some quantity through cutting the heroin. So the lifestyle which provides support, identity and purpose actually presents greater risks and hazards than the heroin.

Today, with our increased awareness and understanding of stress, its causes and its effects on our behaviour, with our acceptance of an increasingly stressful lifestyle which makes greater demands on individuals than ever before, we should find it easy

to understand the motivation of the heroin addict. But heroin-dependent people are still outcasts from all but their own circle. Treated with a mixture of fear and disapproval, they are often viewed as morally weak and degenerate, or as drop-outs protesting against the system. They seem to represent a threat to the security of a conventional lifestyle.

In fact heroin users are just one of the casualties of our established system. Young people today are fully aware of the presence of mood-altering drugs in their homes, regularly being used by their parents. The fact that parents continue to use and abuse legal drugs while expressing concern and disapproval over illegal ones is confusing. Does it mean drug abuse is acceptable as long as the drug is legal? If abusing a legal drug is acceptable behaviour, will using an illegal drug be interpreted as a form of protest? In fact older people's attitudes of shock, horror and disapproval often encourage young people to try heroin out of rebellion or the need to adopt a totally different and independent lifestyle. Few people, irrespective of age or status, perceive heroin abuse as part of an overall drug problem which can be traced to the cocktail cabinet or the bathroom cupboard.

The cracks in society can be clearly seen in the increasing use of licit and illicit mood-altering drugs. People of all ages and backgrounds are failing to find satisfaction, fulfilment and peace, in either physical, emotional or intellectual terms. The pain of this frustration can be dulled with chemicals, but just as an aspirin only alleviates the symptoms of headache, this pain too is the sign of a deeper malaise which drugs cannot cure.

Young people today have grown up with the nuclear threat. Through sophisticated broadcast media they have been exposed to the graphic reality of people's inhumanity to others in a way that previous generations never were. They have been warned endlessly of the inevitability of unemployment, a situation which renders them powerless and denies them access to a world of material success and possessions. Combined with all the other stresses of the onset of maturity, it is not surprising that the city streets show many casualties.

The media in all their forms are largely responsible for the limited perception of the drug problem by the person in the street. While they must accept some responsibility, it is important to realise that responsibility is something separate from blame. It is the job of journalists to find and write stories which will sell papers. A story about a junkie, about crimes committed to get money to buy drugs, is a story which sells. So are stories of the discovery of tonnes of narcotics or fields of marijuana. Alongside these the daily crop of stories concerning smoking or alcohol are pretty dull. People generally don't want to read bad things about their favourite legal drugs, and so these stories do not appear.

So illegal drugs, and heroin in particular, get the full dramatic treatment. This has several effects. It distracts attention from the major problems of the legal recreational drugs. It defines the drug problem as existing only among illegal drugs. It draws attention to the drug and sparks an interest among young people. It reinforces the

misconception that because illegal drugs are 'dangerous', legal drugs are therefore safe. It bestows a certain status and identity on those who use the illegal drug, defining a pattern of behaviour and lifestyle in a way that is misleading and often appealing. It makes pariahs of the drug and the users.

3.

In recent years different treatment options have opened up for heroin users, all of which are primarily designed to improve physical health, draw addicts away from illegal drugs and the associated criminal lifestyle, break their dependence on heroin and help them function in society. A threefold system of drug treatment is used in Australia and different aspects work best for different people. Drug problems are the problems of individual personalities so obviously treatment must cater for a variety of personality needs. The treatment generally involves three stages: detoxification, maintenance, and a therapeutic community. Some people undergo all three; some bypass maintenance and pass straight to the therapeutic community; while others go on to a maintenance program from which they may later be weaned or which may involve a lifetime commitment.

Detoxification is the name given to the process of ridding the body of its accumulated poisons. When the drug supply is withdrawn suddenly, rather than slowly decreased, the process is known as going 'cold turkey'. Sometimes this stage is eased by the use of other drugs, prescribed to help the person over the difficult period. Some of the minor tranquillisers are used to reduce the feelings of anxiety or panic. Other alternatives are drugs which stop the emergence of withdrawal symptoms, or those which block the action of the drug of addiction.

Detoxification is an important part of treatment which can be administered on an outpatient basis or in hospital. The process can last for up to three weeks. Detoxification alone is not a generally successful option in the long term. When the process is combined with counselling the results are more encouraging. The number of people who come through detoxification and stay drug-free without any help is about 2 per cent. Most undergo the process only to go back on drugs again within a matter of days if they receive no other help.

Many people express surprise that, having survived the distress and discomfort of detoxification, addicts so quickly revert to their old habits. But it is not difficult to understand the reasons. Although the body has been cleared of the drug the original reasons for taking it still remain. People are faced with the same fears, anxieties and stresses that preceded the drug habit. But the situation is often worse now because they have the new problem of being an ex-addict and having to find themselves all over again. Jobs are likely to have been lost, family and non-drug taking friends alienated. The detoxification process does not equip the individual with coping skills which were initially lacking. It does not teach new behaviour patterns, so it is natural enough that the detoxified person will drift back to the drug-taking environment and will soon be using the drug again.

Maintenance is a system of keeping the user away from the subterranean existence of hustling for money and drugs and using them in non-sterile conditions. This system substitutes measured doses of another opiate drug, in sterile conditions, within the law

and under professional supervision. In Australia maintenance takes the form of the methadone program.

Methadone is a synthetic opiate which differs from heroin in two important ways. It can be taken by mouth, either neat or made more palatable by adding orange juice. It is long acting while heroin is short acting. The effects of methadone last for twenty-four hours, compared to heroin's effect of four to six hours.

People on methadone maintenance do not suffer from withdrawal symptoms and can function normally. They have normal energy levels and are mentally alert - an important factor for people trying to re-establish themselves and redirect their lives. Methadone does not cure opiate addiction, however, because it is itself an opiate and addictive. After a period during which they have been able to learn new coping skills and modify their behaviour, a small percentage of users can be successfully weaned off methadone. For the majority, however, it is a lifelong commitment.

There are many critics of the methadone program who argue that it is simply substituting one drug for another without attempting to break the drug habit. While this is true, it is important to accept the fact that methadone maintenance effectively removes addicts from the illegal drug scene and all its dangers, restores them to health and helps them to function normally in society. The fact that it is administered daily means that the person is in constant contact with professional help and has access to counselling services whenever required.

If we look at the methadone program for what it is - a maintenance program designed to keep addicts off the illegal drug scene - then few could deny that it is an efficient, successful and highly desirable alternative to heroin addiction. Methadone maintenance does not solve the problem of opiate addiction, however, because methadone alone does not address the underlying cause of that addiction.

The therapeutic community principle has grown since 1958 when a American ex-alcoholic and drug addict, Chuck Dedrich, established Synanon, a new type of treatment centre. Dedrich modelled his centre on the principles of Alcoholics Anonymous. The idea behind the therapeutic community is to effect a complete change in the addict's behaviour by offering a totally different lifestyle. The community is completely drug-free and demands that the ex-addict reject any sort of criminal or antisocial behaviour associated with the old lifestyle. The community is a group effort in which each member has special responsibilities for its successful daily operation.

Most therapeutic communities are located away from big cities, which are centres of drug distribution and full of the temptations of recreational drugs. The life is simple and healthy and involves group therapy during which each member attempts self-analysis and recognition. The atmosphere is non-judgmental and has the strength of shared experience. Because each individual has travelled the same road, the group is effective in breaking down individual barriers of lying and denial. Once these are

stripped away individuals can start the process of rebuilding their lives and learning to cope without drugs.

The therapeutic community replaces the lost magic of the drug subculture and provides a secure and non-threatening environment with which the individual can identify. It provides occupation, a sense of purpose and belonging, the gratification of work and the pleasures of progress and achievement. The main problem with a therapeutic community is keeping a person there long enough to start enjoying its benefits. If individuals can be kept in the community for an initial period then the chances of long-term retention and then rehabilitation are high. There is, however, a fairly high drop-out rate during the first couple of weeks.

One model of the therapeutic community which has been extremely successful is Odyssey House. Odyssey was originally established in the US by Dr Judianne Densen-Gerber, and introduced into New South Wales in 1977. The Australian structure of Odyssey is rather different to the American because the clients are different. In America clients are predominantly working-class people. Here the problem is greatest among the children of middle-class people and prominent Australians. As a result Odyssey has considerable support from establishment sources.

The Odyssey House model is strictly disciplined in comparison with many other therapeutic communities. It works on extensive verbal confrontation between members and extensive self-criticism sessions. For some it provides an ideal environment; others who find it too restrictive are better served by less severe regimes. Dr Densen-Gerber claims a success rate of 80 per cent with addicts who stay six months or more. As with other communities, however, the drop-out rate in the early stages is high.

The only answer to the heroin problem would appear to be one of prevention rather than cure, and preventing a drug problem means addressing the underlying causes of drug abuse. Such a solution demands extensive and long-term commitment of governments and individuals.

Over recent years Dr Densen-Gerber, the founder of Odyssey House, has hammered home the social factors which lead young people towards addiction to heroin and other drugs. She has spoken of the hypocrisy which allows the use of one drug for the old but discriminates against a less harmful drug that is the choice of the young. She has spoken of the pervasive atmosphere of affluence and permissiveness which has broken down family structures, creating confusion and insecurity for the young. She has spoken of a permissiveness which involves too much giving on the part of parents, combined with low expectations and demands in return. She has attacked a society in which family relationships and the home take second place to material wealth and success.

Dr Densen-Gerber has highlighted work as a major factor in the development of individual identity and dignity, and exposed the way in which unemployment robs the

young of this essential. Finally she has attacked the emergence of the nuclear family, calling it 'the first act of violence against the young' and enlarging upon the intense demands and stresses placed on individuals by the limitations of the nuclear family. Young people, she has said, need extended families which incorporate many generations and many helping hands.

In highlighting the major cause of heroin addiction she has pinpointed some of the issues that must be considered if we, as individuals or as a nation, are to take steps to prevent young people from seeking relief in heroin.

APPENDIX 3

TIME PLAN FOR STEPS IN THE DATA COLLECTION PROCEDURE

Timing was not rigid, and varied for each participant.

3.00 pm	preliminaries; outline steps of procedure; collect demographics; present hypothetical task
3.20 pm	prior knowledge: reflection, thinking about what respondent already knows
3.30 pm	recorded discourse: prior knowledge
4.00 pm	researcher analysis of recorded discourse (respondent takes break)
4.15 pm	verbal protocols
4.30 pm	information exposure 1: reflection, thinking about what respondent already knows
4.40 pm	recorded discourse: after information exposure 1
5.10 pm	researcher analysis of recorded discourse; respondent take dinner
5.25 pm	verbal protocols
5.40 pm	Information exposure 2: reflection, thinking about what respondent already knows
5.50 pm	recorded discourse: after Information exposure 2
6.30 pm	researcher analysis of recorded discourse
6.45 pm	verbal protocols
7.00 pm	Information exposure 3: reflection, thinking about what respondent already knows
7.10 pm	recorded discourse: after information exposure 3
8.00 pm	researcher analysis of recorded discourse
8.15 pm	verbal protocols
8.30 pm	debriefing

Australia
Tel. +61 2 330 1990
Fax +61 2 330 1551

University of Technology, Sydney

APPENDIX 4

SOME BACKGROUND INFORMATION

AGE: Years:.....Months:.....

OCCUPATION OF PARENTS / GUARDIANS:

1.....

2.....

YOUR BIRTHPLACE: .....

DO YOU SPEAK A LANGUAGE OTHER THAN ENGLISH AT HOME?

Please tick: YES..... NO:.....

If yes, please indicate the language: .....

BRIEFLY DESCRIBE YOURSELF AS A STUDENT

.....
.....
.....
.....
.....
.....
.....
.....
.....

Office City campus, No.1 Broadway, Sydney NSW
Campuses City, Kuring-gai, St Leonards

APPENDIX 5

TABLE 21
INDICATORS OF *GET A COMPLETE PICTURE* FOR EACH GIRL

GET A COMPLETE PICTURE
GIRL #1
General (G)
G1 I now know a lot of things I didn't know before
G2 I got a lot of new information from the sheets
G3 but I've learned a great deal more
G4 it gave examples - made concrete some of the general things I've said
G5 I was able to make links to other information
G6 it triggered some stories my mother told me
Specific (S)
S1 get a more complete picture: that's an expanded picture, you know more about an idea and what is related to it, for example, the reasons why people take drugs
S2 it spells out all the side effects in detail. I learned many specific effects I didn't know
S3 add specific detail, for example, the withdrawal symptoms
S4 the information put specific amounts on the fines and sentences
S5 there was a lot of new information here; before I know almost nothing about how heroin addicts are treated
S6 it triggered other information I already knew; the information was not remembered the first time round, such as my grandmother on morphine
S7 I was able to relate what I thought at first were unrelated ideas, for example, heroin, opium and morphine
S8 I didn't realise heroin was connected to AIDS. I've known about AIDS through school and the media
S9 that triggered my memory; I knew some of the effects of intravenous use, like hepatitis

GET A COMPLETE PICTURE

GIRL #2

General (G)

G1 I learned a lot of new information

Specific (S)

S1 the new information gives me specific examples to work with, such as examples of the specific effects
S2 I didn't know all the specific effects before
S3 I didn't know that it reduces appetite
S4 I wasn't aware before of all of the forms and details of treatment
S5 methadone and its use was a new concept for me
S6 I learned of the psychological effects and its dangers
S7 the information said that heroin goes back before Christ. I didn't know that before
S8 I didn't know before that heroin came from opium
S9 I knew that opium was used a long time ago, but I hadn't made the connections between opium and heroin. I always knew opium was connected to Asia and China
S10 what was written triggered things I knew before but hadn't thought of at the time, like Coleridge and the subcultures
S11 the information said it was less harmful to your body than alcohol

GIRL #3

General (G)

G1 I was able to make connections

Specific (S)

S1 I've come to learn about all the different forms of treatment. I didn't know them before
S2 I've found out also that heroin comes in different forms
S3 I wasn't sure where heroin was obtained from, but I now know that the drug is from the unripe seeds of the poppy
S4 I learned a lot more about the detail of the specific effects. I wasn't aware of the specific effects as I hadn't realistically witnessed them
S5 I found out more reasons why people take heroin
S6 I learned that the added ingredients posed greater danger, I didn't know this
S7 the article triggered off stories of desperation to which users go to the which I've heard about

GET A COMPLETE PICTURE

GIRL #4

General (G)

G1 I found a lot of new information

Specific (S)

S1 learn whole new blocks of information - I didn't know anything about the history of the drug
S2 gives a more detailed picture, such as all the effects
S3 builds a bigger picture such as all the effects
S4 I learned a whole lot of new information about why people take heroin
S5 I didn't know that heroin came from opium ... I didn't realise that opium came from poppies
S6 almost all the treatment information was new
S7 well, it broadens the picture such as what I know about dependency

TABLE 22
SUMMARY OF CHANGES TO KNOWLEDGE STRUCTURES
ASSOCIATED WITH PERCEIVED EFFECT
GET A COMPLETE PICTURE
note: indicators based on those in Table 21

GIRL #1

indicator	no.	level	cognitive strategy	change in knowledge structure	construct
S1	a	base -> 1	appending	add example (specific instance) of "escape" (concept in a proposition) cite real world instance- general -> concrete	add set membership of concept in a proposition
S1	b	base -> 1	appending	add specific type and its negative outcome to more inclusive node	add set membership; add goal-oriented substructure
S1	c	base -> 1	appending	add new "reason" to organising concept "why take heroin" and elaborate with definition, causal factors and consequence	add set membership of organising concept; elaborate with cause-oriented structure
S1	d	1 -> 2	appending	add new "reason" to organising concept "why take heroin" and elaborate with related sequence of events and specific consequences	add set membership to organising concept; elaborate with events chain / cause-oriented substructure
S1	e	1 -> 2	appending	add new "reason" to organising concept "why take heroin" and elaborate with explanation relating to goals	add new dimension of organising concept; elaborate with goal-oriented substructure

GIRL #1

indicator	no.	level	cognitive strategy	change in knowledge structure	construct
S1	f	1 -> 2	appending	add specific type to more inclusive node "escape or forget problems"; elaborate with implicational statements	add set membership of concept in proposition; elaborate with implies-oriented substructure
S1	g	1 -> 2	appending	add more inclusive node to specific type specific -> general	derive more inclusive class from set membership
S1	h	1 -> 2	appending	add consequence to specific type	elaborate with cause-oriented structure
S1	i	2 -> 3	inserting	add explanation to a relationship	elaborate argument; elaborate goal-oriented structure
S2	a	base -> 2	appending	add specific type to more inclusive node; add some elaboration with causes and consequences this leads to (b)	add set membership of concept in proposition; elaborate with cause-oriented substructure
S2	b	base -> 2	appending	add specific type to more inclusive node; add some elaboration with causes and consequences	add set membership of concept in proposition; elaborate with cause-oriented substructure
S3	a	base -> 2	appending	add specific type "withdrawal symptoms" to more inclusive node "effects when users are off the drug"	add set membership of concept in proposition
S3	b	base -> 2	appending	add specific types to more inclusive node "withdrawal symptoms"	add set membership of concept in proposition

GIRL #1

indicator	no.	level	cognitive strategy	change in knowledge structure	construct
S4	a	base -> 1	appending	add specific amount:	add property-oriented node
S4	b	base -> 1	appending	add specific amount:	add property-oriented node
S4	c	base -> 1	appending	add specific types to more inclusive node "use"	add set membership of concept in proposition
S5	a	base -> 2	appending	add specific type "cold turkey" to more inclusive node; elaborate set membership with definition; add position statement	add set membership of concept in proposition; elaborate with property substructure
S5	b	2 -> 3	appending	elaborate specific type: standard nomenclature, specific aspects of process, facts on conditions of success; statistical data on success rates; add modified position statement	elaborate concept with manner and outcomes substructure
S5	c	base -> 1	appending	elaborate specific type with detail about characteristics, process, and impact, including comparison of methadone and heroin	elaborate concept with property, manner, goal nodes
S5	d	1 -> 3	inserting	add explanation of how treatment outcome is achieved	elaborate argument

GIRL #1

indicator	no.	level	cognitive strategy	change in knowledge structure	construct
S5	e	1 -> 3	appending	elaborate specific type with standard nomenclature; facts on history, characteristics, process, success rate; 2 examples elaborated by specific facts;	elaborate set membership with goal, property, manner structures; add set membership of concepts in proposition
S5	f	1 -> 3	inserting	adding facts to explain how - elaborate manner	elaborate argument
S6	a	base -> 1	appending	add recalled facts of morphine	add set membership of organising concept; add property, manner structure;
S6	b	base -> 1	appending	add position statement:	elaborate outcome
S7	a	base -> 1	appending	add facts about botanical and historical origins of heroin: establish relationships between concepts heroin, morphine and opium	add new dimension of organising concept; build property, manner, set membership structure;
S8	a	base -> 2	appending	add facts about process and consequences	elaborate with manner and outcome nodes
S9	a	base -> 2	appending	add specific types eg. hepatitis to more inclusive node	add set membership of concept in proposition

GIRL #2

indicator	no	level	change strategy	change in knowledge structure	construct
S1 S2 S3	a	base -> 2	appending	add specific types eg "it reduces sex drive" of a larger inclusive class "specific effects"; some limited facts on process	add set membership to concept in proposition' elaborate manner
S4	a	base -> 3	appending	add facts: dimensions of the concept "therapeutic communities": properties	elaborate concept with goal, manner, property substructures
S4	b	base -> 3	appending	add specific type "detox" of more inclusive "rehabilitation"; (information recalled from memory)	add set membership of concept in proposition
S4	c	base-> 3	appending	add specific type "maintenance" of more inclusive "treatment"; outline process, characteristics; make judgement of effectiveness	add set membership of concept in proposition; elaborate manner, property, goal, outcome nodes; add position
S5	a	1 -> 2	inserting	by linking to concept "dependency" about heroin add facts to explain relationship	add explanation to relationship
S5	b	1 -> 2	appending	adds "psychological dependency" as a case of "harmful" -> specific type of more inclusive class; elaborates specific type by explaining process	add set membership of concept in proposition; elaborate manner

GIRL #2

indicator	no	level	change strategy	change in knowledge structure	construct
S6	a	2 -> 3	appending	add statement of consequence; add position statement:	add property, consequence and positioning structures
S7	a	base -> 1	appending	add substructure based on organising concept "origin and nature of heroin" which elaborates the dimensions of this organising concept	add organising concept; properties, goal, manner, set membership, outcome, consequence
S7	b	base -> 1	appending	add facts of personal experience: add recalled related information from other sources	elaborate proposition by linking to personal experience
S8	a	base -> 1	appending	add substructure based on organising concept "origin and nature of heroin" which elaborates the dimensions of this organising concept; interrelationships established between opium and heroin	add organising concept; properties, goal, manner, set membership, outcome, consequence : see relationships
S9	a	base -> 1	appending	elaborate the stated connection	elaborate property nodes
S10	a	1 -> 2	appending	add elaboration (characteristics) of "subculture"	property substructure
S11	a	1 -> 2	inserting	explain relationship	add facts of comparison

GIRL #3

indicator	no	level	cognitive strategy	change in knowledge structure	construct
S1	a	base -> 2	appending	add specific types eg. "there are therapeutic communities" of more inclusive node "there is a three fold system of treatment in Australia" elaborate each type with a range of dimensions nomenclature, definitions, processes, conditions, outcomes	add set membership of concept in proposition; elaborate property, manner, goal, and consequence substructures
S2	a	base -> 1	appending	add specific type "sniffed" to more inclusive concept "use"	add set membership of concept in proposition
S2	b	base -> 1	appending	add specific type "tablet" to more inclusive concept "use"	add set membership of concept in proposition
S3	a	base -> 1	appending	add new structure to organising concept starting with node: "heroin comes from unripe seeds of poppy"; elaborate with dimensions: description of plant, process of producing heroin, relationship to morphine; aspects of history	elaborate organising concept through property, manner, goal, outcome nodes
S4	a	base -> 2	appending	add specific types eg "it could stifle fertility" to more inclusive node "there are many specific effects"; one consequence fact	add set membership of concept in proposition; add consequence node
S5	a	base -> 1	appending	add new "reason" to organising concept "why take heroin"	add to set membership
S5	b	base -> 1	appending	add new "reason" to organising concept "why take heroin"	add to set membership

GIRL #3

indicator	no	level	cognitive strategy	change in knowledge structure	construct
S6	a	base -> 1	inserting	insert example: "Russian Roulette" as basis for comparison; comparison establishes magnitude of risk	add set membership of concept in proposition
S6	b	base -> 1	appending	add specific types to more inclusive node	add set membership of concept in proposition
S6	c	base -> 1	inserting	add facts about process to fill out relationship	elaborate manner - explain relationship
S6	d	1 -> 2	appending	add process-outcomes sequence	add sequence of state, manner, consequence
S7	a	base -> 2	appending	elaborate proposition with conditional statement; add facts acknowledging sources of stories; stories not acknowledged previously - 2 specific types of stories identified	elaborate manner; add set membership
S7	b	base -> 2	appending	elaborate proposition with reason for goal	elaborate goal node

GIRL #4

indicator	no	level	cognitive strategy	change in knowledge structure	construct
S1	a	base -> 1	appending	replace incorrect fact with new organising proposition; add facts to build up concept: dimensions of concept: history, use, characteristics,	elaborate concept with events chain, goal, manner substructures
S2	a	base -> 2	deleting	remove incorrect fact leading to (b)	reduce map; increase accuracy of map
S2	b	base -> 2	appending	replace incorrect fact with new fact; add dimensions of concept (add specific type to more inclusive node): elaborate each dimension with specific types of each more inclusive node: build 2 set memberships; some sets elaborated with processes and consequences	add set membership to concepts in proposition; elaborate with manner and cause-oriented structure
S3	a	base -> 1	appending	add new "reason" to organising concept "why take heroin" and elaborate with characteristics	add set membership to organising concept; elaborate with properties structure
S3	b	base -> 1	appending	add new "reason" to organising concept "why take heroin" and state consequence	add set membership to organising concept; elaborate with cause-oriented structure

GIRL #4

indicator	no	level	cognitive strategy	change in knowledge structure	construct
S3	b	base -> 1	appending	add new "reason" to organising concept "why take heroin" and state consequence	add set membership to organising concept; elaborate with cause-oriented structure
S3	c	base -> 1	inserting	adds explanation: links use to popular singers	elaborates argument to explain relationship
S3	d	base -> 2	appending	add new "reason" to organising concept "why take heroin" and add small sequence of specific consequence	add set membership to organising concept; elaborate with cause-oriented structure
S3	e	base -> 2	appending	add new "reason" to organising concept "why take heroin" and elaborate with explanation of "how" and consequence: manner and consequence	add set membership to organising concept; elaborate with manner and consequence structures
S3	f	base -> 2	inserting	add nodes: elaborate relationship with process sequence	explain relationship with manner substructure
S4	a	base -> 1	appending	add substructure that elaborates botanical origins: characteristics; sequence of production:	elaborate with property and manner substructure
S5	a	base -> 1	deleting	remove incorrect fact	reduce structure; increase accuracy

GIRL #4

indicator	no	level	cognitive strategy	change in knowledge structure	construct
S5	b	base -> 1	appending	add 2 dimensions of "treatment" specific types of concept "treatment": detail definitions, purpose, characteristics, process, impact, and success rates	add set membership to concept of established proposition; elaborate wit manner, property and outcome substructures
S5	c	base -> 1	appending	brings two substructures based on specific types together by appending position statement on "drug education programs"	unites two separate substructures adds positioning substructure
S6	a	base -> 2	inserting	add explanation of relationships through providing stages of process between the 2 nodes	add argument
S6	b	base -> 2	appending	add facts that elaborate the argument of (a) describes characteristics of "lifestyle"	elaborates manner and goal substructures
S6	c	base -> 2	deleting	remove substructure on Alice	reduce structure
S6	d	base -> 2	appending	replace substructure with generalisation; summary node: deleted structure subsumed by example	add set membership
S6	e	base -> 2	inserting	add sequence of process that explains relationship	elaborate argument with manner substructure

TABLE 23
INDICATORS OF *GET A CHANGED PICTURE* FOR EACH GIRL

GET A CHANGED PICTURE
GIRL #1 General (G) G1 it corrected something that was wrong - corrected facts G2 I've changed my mind many times - new facts that show some of my facts were wrong G3 it corrects what is wrong, you thought something before and it isn't right Specific (S) S1 I thought before that addiction happens after the first try. Now I know that this isn't so. It takes time S2 Some of the effects I mentioned like heroin causing violence before are wrong; this is opposite to what I said before S3 I've changed my view in terms of it [detox] being the best way S4 I said before that morphine is extracted from heroin. I've changed my mind
GIRL #2 General (G) G1 you can get your facts right G2 you can change your mind Specific (S) S1 I always thought before that heroin was a relatively new drug. That was wrong. Heroin originated long before Christ S2 correction - I had previously thought that heroin was extremely harmful to one's health. Since reading the information I've changed my mind S3 I didn't realise that heroin was non-violent when people are on it. I thought the opposite. They become tranquil and calm S4 it surprised me that heroin has a calming effect. I thought it caused violence S5 the reason I've had for the images is not correct

GET A CHANGED PICTURE

GIRL #3

General (G)

G1 I found some of my ideas were wrong, so I changed them

Specific (S)

S1 identified what I mistakenly thought to be correct, like that heroin was a modern drug
S2 I was not aware that the drug was known and used for a long time; I was surprised that the history of heroin was so long - before, when I thought of heroin, I thought of today' drug addicts
S3 I've said before that it affects all of the organs of the body, that's not so, it is in fact less harmful than alcohol. I've fixed that up
S4 the information has changed my perceptions of the drug, especially knowing that alcohol is just as dangerous
S5 the detail and accuracy of the information helped change my ideas, such as how the linking of taking drugs with prostitution isn't true
S6 I was wrong when I said that addicts are treated in hospital. It seems as if they are not treated in hospital.
S7 the baby image isn't a good one, this is wrong, given what I've read about the calming effects

GIRL #4

General (G)

G1 I changed some of my ideas

Specific (S)

S1 This is a change. Heroin starts off as a powder, not a liquid first
S2 I always thought heroin was a recent modern discovery. I didn't realise it goes back a long time
S3 The drug does little physical damage to the organs of the body. I thought the opposite of this before.
S4 I had always associated using heroin with violence. This is not correct.
S5 I had thought previously that addiction happens very quickly. Wrong again

TABLE 24
SUMMARY OF CHANGES TO KNOWLEDGE STRUCTURES
ASSOCIATED WITH PERCEIVED EFFECT
GET A CHANGED PICTURE
note: indicators based on those in Table 23

GIRL #1

indicator	no.	level	cognitive strategy	change of knowledge structures
S1	a	1 -> 2	appending	adding facts (definition) to get a complete picture; adding a position statement (appears to be on basis of this one fact)
S1	b	2 -> 3	appending	elaborate specific type: standard nomenclature, specific aspects of process; facts on conditions of success; statistical data on success
S1	c	2 -> 3	deleting	remove incorrect fact: changed position statement
S1	d	2 -> 3	appending	replacing corrected fact: modified position statement
S2	a	base -> 1	appending	adding facts: add specific types to more inclusive node. This appears to establish that type mentioned "people may become violent" is in conflict with new specific fact "people become calm
S2	b	base -> 1	deleting	remove incorrect fact: delete specific type that is incorrect (in the context of types)
S2	c	base -> 1	appending	replacing corrected fact "people are less violent" - add correct specific type
S2	d	base -> 1	appending	repositioning of original fact: original fact put into new context ie. "violence related to crimes ..."
S3	a	base -> 2	deleting	remove incorrect fact: incorrect fact is a statement on the process of addiction: the nature of the process is changed
S3	b	base -> 2	appending	adding correct fact: new statement of process added; appended to this process is an elaboration

GIRL #1

indicator	no.	level	cognitive strategy	change of knowledge structures
S3	c	base -> 2	appending	adding 2 position statement: the position statements appear to reinforce the unstated assumption in the removed fact - that addiction happens quickly; while this is not stated, the position statement appear to be confirmation of it
S4	a	base -> 1	appending	add facts: about history, nature and botanical origins; this establishes relationship between opium, morphine and heroin; new proposition "morphine is extracted from heroin" contradicts original proposition
S4	b	base -> 1	deleting	delete incorrect fact: contradictory proposition is deleted
S4	c	base -> 1	inserting	repositioning: 3 nodes, part of original set of facts about "morphine is used medically" are retained, but repositioned in new context - that of use of morphine by "grandmother"
S4	d	base -> 1	appending	position statement is appended as part of this repositioning process

GIRL #2

indicator	no.	level	cognitive strategy	change of knowledge structures
S1	a	base -> 1	deleting	delete incorrect fact: 1st exposure on history of heroin establishes its long chronology: opening proposition is judged to be wrong
S1	b	base -> 1	appending	replaced with corrected fact
S1	c	base -> 1	appending	verifying deletion: acknowledging starting proposition was incorrect
S1	d	base -> 1	appending	elaborate with facts: adding extensive substructure on historical origins of heroin; this facilitates other structural changes
S2	a	base -> 1	deleting	delete incorrect fact: related to extent of harm caused by heroin

GIRL #2

indicator	no.	level	cognitive strategy	change of knowledge structures
S2	b	base -> 1	appending	replace with corrected fact: modified proposition: "less harmful than alcohol" The concept of harm is still retained; extent identified by comparison with "alcohol": modification of perceived level of harm
S2	c	base -> 1	appending	add facts about level of harm: verification
S2	d	base -> 1	deleting	removing redundant fact, as proposition incorporated into verification
S3 / S5	a	1 -> 2	deleting	delete incorrect fact
S3 / S5	b	1 -> 2	appending	placing corrected fact; clarify context; resolve contradiction
S4	a	base -> 1	appending	confirmation - verify facts
S4	b	1 -> 2	appending	add facts: set membership
S4	c	1 -> 2	deleting	remove incorrect nodes - judged to be incorrect
S4	d	1 -> 2	appending	add correct node
S4	e	1 -> 2	inserting	add facts, clarify relationships
S4	f	1 -> 2	appending	add fact, property
S4	g	1 -> 2	deleting	remove incorrect relation
S5	a	base -> 2	appending	add set membership details of effects
S5	b	base -> 2	deleting	remove incorrect node
S5	c	base -> 2	appending	add correct fact

GIRL #3

indicator	no.	level	cognitive strategy	change of knowledge structures
S1/ S2	a	base -> 1	deleting	remove incorrect node: the original proposition "... before when I thought of heroin, I thought of today's drug addicts". This proposition is inconsistent with set of new facts provided and later to be appended
S1/ S2	b	base -> 1	appending	append new starting proposition: "history tells a long story of individual using heroin"
S1/ S2	c	base -> 1	appending	add facts: add major substructure about history of heroin

GIRL #3

indicator	no.	level	cognitive strategy	change of knowledge structures
S3	a	base -> 1	appending	the new information establishes the proposition "it is less harmful than alcohol"; and in verbal comments, acknowledges that initial statement is not correct
S3	b	base -> 1	deleting	remove initial proposition: "it affects your organs", and 5 other nodes related to it that elaborate the process and effect on the organs
S3	c	base -> 1	appending	added to the new starting proposition is the node "while it is less harmful, it is the misuse that weakens the body". The conjunction while implies opposition or contrast, highlighting the incorrectness of original proposition (verification), but enables the conclusion of the original sequence to be accepted.
S3	d	base -> 1	appending	the remaining 2 propositions left after the deleting, ie. the original conclusion, is now appended to the new sequence
S4	a	1 -> 2	appending	a changed "perception" implicit in deletings above, rather than in the substructure where the appended node appears; change in perception acknowledged by adding set of personal opinions about how alcohol and other drugs are serious drugs and the need to view heroin in light of this
S5	a	base -> 2	appending	add fact: add specific instance of more inclusive node on side effects; enables making judgement that "myth that heroin is associated with sexual promiscuity"
S5	b	base -> 2	appending	add judgement: verifies that initial proposition was incorrect
S4	c	base -> 2	deleting	remove incorrect fact

GIRL #3

indicator	no.	level	cognitive strategy	change of knowledge structures
S5	a	base -> 2	appending	add fact: add specific instance of more inclusive node on side effects; enables making judgement that "myth that heroin is associated with sexual promiscuity"
S5	b	base -> 2	appending	add judgement: verifies that initial proposition was incorrect
S4	c	base -> 2	deleting	remove incorrect fact
S6	a	base -> 3	deleting	remove incorrect fact: incorrect form of treatment; immediate nodes to this starting with "they try to help addicts" are retained as they are general statements on purpose of treatment
S6	b	base -> 3	appending	add correct facts: general proposition about forms of treatment; purpose statements rejoined to this
S7	a	base -> 3	deleting	remove incorrect facts: 4 nodes deleted: these are a comparison to a baby without its pacifier to illustrate dangers associated with treatment of addicts. New information about nature, process and outcomes of treatment (get a complete picture) seems to have brought on the assessment of the use of this image
S7	b	base -> 3	appending	add new fact: a general inclusive statement added "all have their own dangers and risks"

GIRL #4

indicator	no.	level	cognitive strategy	change of knowledge structures
S1	a	base -> 1	appending	add new facts; create conclusion out of starting proposition. The original starting proposition "heroin will come in liquid form" is not wrong, hence is not deleted; its position in the sequence of ideas is shifted to a conclusion, with two nodes appended to the front of it - what is wrong is how originally start out: the new sequence shows how heroin becomes "liquid form"
S2	a	base -> 1	deleting	remove incorrect fact. The new information establishes that "heroin was discovered in recent years" is incorrect; original proposition is deleted
S2	b	base -> 1	appending	new starting proposition is established: "heroin is prominent in history" and it replaces incorrect fact
S2	c	base -> 1	appending	add organising nodes to new starting proposition: dimensions of the history - inclusive nodes to develop chronological sequences
S2	d	base -> 1	appending	add facts: sequences added to each organising concept to elaborate set membership
S3	a	base -> 1	deleting	remove incorrect fact: new information enables acknowledgment that initial proposition "heroin has big effect on the body" is wrong, it is deleted
S3	b	base -> 1	appending	replacing corrected fact: "heroin does little physical damage to the body
S3	c	base -> 1	appending	organising nodes now added: form the basis for elaboration of set membership substructures
S3	d	base -> 1	appending	add facts: add set membership
S4	a	base -> 2	deleting	remove incorrect fact: fact based around concept of "violence"

GIRL #4

indicator	no.	level	cognitive strategy	change of knowledge structures
S4	b	base -> 2	appending	replacement node still incorporates concept of violence: conditions ' context of concept have been changed
S4	c	base -> 2	appending	repositioning in new substructure: appended into a newly created structure built around concept "withdrawal symptoms"
S5	a	base -> 3	deleting	remove incorrect fact "treatment is done through media campaigns" This is based on information exposure detailing specific facts of treatment; outcome node attached to this is retained
S5	b	base -> 3	appending	confirm deletion: "media campaigns are not a treatment"
S5	c	base -> 3	appending	replace with organising nodes: inclusive node about form of treatment; and two nodes based on this to identify two types of treatment
S5	d	base -> 3	appending	elaborate set membership
S5	e	base -> 3	inserting	position; link substructures (as discussed earlier)
S5	f	base -> 3	appending	establish conclusion; confirm original outcome node

TABLE 25
INDICATORS OF *GET A CLEARER PICTURE* FOR EACH GIRL

GET A CLEARER PICTURE
GIRL #1 General (G) G1 it explains things Specific (S) S1 it clarified some of the general statements I've made, like how methadone reduces addiction. It explains things S2 I now understand eg. how heroin came to Australia in the Vietnam War S3 however, I realised that in my mind, the high cost had been confused with the cost of crack and cocaine S4 that also makes a lot of sense to what I've learned here. If you don't eat, you won't have the energy to be violent. Yes, I now understand why violence doesn't happen S5 I understand the impurity problem a lot more clearly now
GIRL #2 General (G) G1 it helps to clarify things I didn't understand before Specific (S) S1 I understand more clearly how heroin takes over your thinking

GET A CLEARER PICTURE

GIRL #3

General (G)

G1 I could sort out my fuzzy ideas
G2 the detail clarified the vague general things

Specific (S)

S1 gives reasons to explain things. Like the problem of addiction, why it was ignored - they didn't realise it was addictive. The reasons help me understand the problem. I knew the problem existed, but wasn't clear why
S2 it clarifies an idea. For example, explaining why the criminal network in Australia grew
S3 I understand now more clearly how the media influences people to take drugs
S4 this new information explains things you didn't understand before, like the problem with legal drugs and how the media covers this up
S5 I realise that I was confused before when I got all the effects mixed up. I could group my ideas better. It made sense
S6 it explains a sequence; I know now what the steps are, for example, the smuggling of the drug into Australia started with events in Vietnam
S7 I got the psychological and physical effects a bit mixed up. This clarifies what I know. I've sorted out my ideas a bit more. There seems to be phases which an addict goes through with the drug
S8 I can understand more convincingly why heroin shouldn't be made legal
S9 I can see more clearly how the drug and its treatment is an individual problem
S10 the information made it more real and serious (eg. the media portrays images of general effects that are not so alarming)

GIRL #4

General (G)

G1 gives you background information - it clarifies the picture
G2 gives more reasons for something - makes a stronger argument; makes it more convincing

Specific (S)

S1 you can explain things, you can give reasons like why the community rejects addicts
S2 I understand better why people take drugs. The information explained it

TABLE 26
SUMMARY OF CHANGES TO KNOWLEDGE STRUCTURES
ASSOCIATED WITH PERCEIVED EFFECT
GET A CLEARER PICTURE
note: indicators based on those in Table 25

GIRL #1

indicator	no.	level	cognitive strategy	change in knowledge structure
S1	a	1 -> 3	appending	adding of substructure: elaborative change - establishes process, goal, outcome.
S1	b	1 -> 3	inserting	appending enables inserting of sequence of nodes between two initial propositions: "they are also injected with some other type of drug" and "this helps to stop you from wanting to take it". The initial relationship is one of event -> consequence. The inserting explains the process of how it helps, based on the non-addictive effect of methadone.
S2	a	base ->1	appending	a substantial appending explains how heroin came to Australia. This appending appears to be based on unstated knowledge that heroin has not always been in Australia. The appending is largely a process-oriented and cause-oriented substructure, with consequences established. "Understanding" appears to be equated with "get a complete picture" here.
S3	a	base ->1	appending	the appending of 2 nodes establishes set membership. The resolution "that the high cost had been confused with the cost of crack and cocaine" is not really evidenced in the change of structure because there is no acknowledgment of the initial dilemma. The clearer picture is deduced from the set membership facts
S4	a	base ->2	appending	the appending of set membership details of side effects includes "people become calm". A logical connection is made to the concept of "violence", and this concept is repositioned in a new context (that of crimes rather than effects of drug)

GIRL #1

indicator	no.	level	cognitive strategy	change in knowledge structure
S5	a	base ->1	appending	at this stage, 3 small appendings take place: these are 2 set membership appendings, and 1 is reason-outcome sequence
S5	b	1 -> 2	inserting	explains how
S5	c	1 -> 2	inserting	explains why
S5	d	1 -> 2	inserting	explains why

GIRL #2

indicator	no.	level	cognitive strategy	change in knowledge structure
S1		base -> 1	inserting	between nodes "all other decisions are made in relation to this" and "need for heroin overrides rational thinking": 8 nodes inserted - cause-effect substructure that explains both why and how it overrides rational thinking

GIRL #3

indicator	no.	level	cognitive strategy	change in knowledge structure
S1	a	base -> 1	appending	a substantial appending based on the historical chronology of heroin presented after 1st exposure. The theme is developed relating to problem of addiction through history. Facts presented in chronological sequence using cause-effect structures
S2	a	base -> 1	inserting	a substantial inserting of 7 nodes between "dealers try and smuggle the drug" and "criminal network was established". Nodes describe sequence of cause-effect events that provide an explanation of how it was established and how this led to smuggling
S3 / 4	a	base -> 1	inserting	between "media publicises the drug" and "it makes people curious about the drug" - 2 nodes inserted that explains "how" media publicises the drug; appended to "it makes people curious about the drug" is a cause-effect sequence that establishes outcome of "curiosity", and a set of specific reasons for this curiosity (set membership)

GIRL #3

indicator	no.	level	cognitive strategy	change in knowledge structure
S3 / 4	b	base -> 1	inserting	between "these idols take the drug" and "it makes people curious about the drug"; builds the argument further
S3 / 4	c	base -> 1	inserting	between "media publicises the drug" and "it makes people curious about the drug" - 2 nodes inserted that explains another reason for "how" media publicises the drug; appended to various nodes that elaborate the picture
S5 / 10	a	base -> 2	appending	the appending elaborates "these images are from TV". The appending is primarily a cause-effect substructure that enables comparison of the effect of heroin with that of alcohol, and media's role; cause-effect sequence is explanatory
S5 / 7	a	base -> 2	inserting	explanation of how
S6	a	base -> 2	appending	set membership details
S8	a	base -> 1	inserting	A position statement had been appended, consisting of 2 nodes "some claim it should be made legal" and "i feel it should not be made legal". The inserting of 2 nodes establishes the problem with "legal drugs" and its impact (cause-effect) and consequence, and provides a "therefore" type of explanation for the viewpoint.
S8	a	base -> 1	inserting	between nodes "heroin users have problems" and "it helps people forget their problems"; inserting is an explanation of why people have problems and impact in relation to heroin use.
S9	a	base -> 3	appending	the development of a substantial substructure based on types of treatment. No evidence for comparisons as stated in indicator

GIRL #4

indicator	no.	level	cognitive strategy	change in knowledge structure
S1	a	base -> 2	appending	added is a goal-reason sequence - first by elaborating a set of reasons why heroin addicts are rejected, and identifying an of outcome of this.
S2	a	base -> 2	inserting	between "dependency is an important effect" and "becomes lethal when the does become larger because of the dependency"; this is an event-consequence sequence that explains the build up of dependency, leading to the consequence of "becomes lethal"
S2	b	base -> 2	inserting	between "heroin in certain doses can be lethal" and "often users can die" - 2 nodes establish the reason for this, related to does of "impure heroin"; cause-effect relationship
S2	c	base -> 1	inserting	between "heroin not used by majority of teenagers" and "some teenagers experiment with drugs": the inserting explains why some teenagers experiment: cause-effect substructure
S2	d	base -> 1	appending	adds a reason why: elaborates set membership - appends reason to organising concept
S2	e	base -> 1	appending	adds a reason why: elaborates set membership - appends reason to organising concept

TABLE 27
INDICATORS OF *GET A VERIFIED PICTURE*
FOR EACH GIRL

GET A VERIFIED PICTURE
GIRL #1 General (G) G1 confirms some of the guesses I've made, like when I started writing the first time, you think you know something but are not certain and then the information tells you that it is G2 when you read, you are reminded how much is common sense Specific (S) S1 it confirmed that it cost a lot. S2 it has side effects which I know; S3 I got some of the effects right, like weight loss and loss of vitality S4 It convinced me that addiction happens quickly
GIRL #2 General (G) G1 I feel stronger about some of my own ideas Specific (S) S1 it strengthens my ideas - like the importance of drug education S2 however, I still believe that heroin has a great effect on personality
GIRL #3 General (G) G1 it doesn't change some things I know. G2 the information told me some things I already knew. I guess it tells me I was right G3 it confirms what I already know, especially when you think you know something thought you're not feeling 100% certain Specific (S) S1 I think I will stick with my viewpoint that it is not a good drug at all because too many people use it the wrong way and it has terrible effects S2 it confirmed that heroin is expensive to buy S3 even more so, because of what all the information said, I won't use heroin

GET A VERIFIED PICTURE

GIRL #4

General (G)

G1 it sort of gives more certainty to what you think; that's a general thing - confirms your own ideas

Specific (S)

S1 you know for certain where before you might have thought something but weren't sure, such as the form heroin comes in

TABLE 28
SUMMARY OF CHANGES TO KNOWLEDGE STRUCTURES
ASSOCIATED WITH PERCEIVED EFFECT
GET A VERIFIED PICTURE
note: indicators based on those in Table 27

GIRL #1

indicator	no.	level	cognitive strategy	change in knowledge structure
S1	a	base -> 2	inserting	simple inserting that involves 1 node and 2 relations. Inserted between the proposition "it is an expensive drug" and "this creates severe financial problems" is a proposition that explicitly states the cost of the drug. Acknowledges that "it confirmed that it cost a lot". The evidence for the perceived effect is inserting. While the change enables getting a complete picture through adding specific detail (set membership), the acquisition and inserting of the actual amount appears to confirm "expensive drug". Confirmation by precision
S2	a	base -> 2	appending	"it has side effects which I knew". According to the base measure, the "knowing" of these side effects was implicit, as they are not shown in any substructure. The building up of a complete picture of the effects is through set membership: inclusive. Verification appears to come through precision of information
S3	a	base -> 2	no change in structure	"I think I got some of the effects right, like weight loss and loss of vitality". No difference in the change structure observed.

GIRL #1

indicator	no.	level	cognitive strategy	change in knowledge structure
S4	a	base -> 2	appending	"It convinced me that addiction happens quickly. and that it doesn't take much to be addicted": In this structure, a change has taken place and acknowledged by respondent as "Get a changed picture" The evidence of the confirmation is in the appending of node: "addiction happens quickly". This notion of "quickly" is implicit in the original node that was removed. It appears to be saying "despite the change in fact, I still believe ..." Despite the change, the girl still think that addiction happens quickly, and needed to make this explicit - idea had been taken away with the change.

GIRL #2

indicator	no.	level	cognitive strategy	change in knowledge structure
S1	a a a	base -> 1 1 -> 3 base -> 1	appending appending appending	"it strengthens my ideas - like the importance of drug education" This is made evident in three of the respondent's knowledge structures. The idea of "drug education" is repeated in three different contexts: it appears to be the repetition of an idea in different contexts that gives the verification: first context: in relation to detoxification as form of treatment - 2 nodes: "treatment needs to focus on prevention" and ""this can be done through the media and schools"; second context: in discussion of therapeutic communities: 2 nodes "this is through social education and drug education" and "this must take place before they start on soft drugs"; third context: in relation to penalties: 2 nodes "further drug education is needed" and "need prevention through exposure to problems at school"

GIRL #2

indicator	no.	level	cognitive strategy	change in knowledge structure
S2	a	base -> 1	appending	"however, I still believe that heroin has a great effect on personality, more so now since I've read the ideas". This is shown in appending: appended to an existing node "it affects the personality" is the node "It has a great effect on personality". The nodes are similar, and the appended node represents a style of the original node. Interesting that it was not deleted - adds emphasis. Repetition was deliberate.

GIRL #3

indicator	no.	level	cognitive strategy	change in knowledge structure
S1	a	base -> 1	appending	"I think I will stick with my viewpoint that it is not a good drug at all because too many people use it the wrong way and it has terrible effects". This indicator is in the context of the comparison of the effects of alcohol and heroin, which appears to reduce the impact of heroin by comparing it to a legal drug. The verification is reflected in the appending of a viewpoint about heroin as a serious problem. The viewpoint is not expressly stated.
S2	a	base -> 2	no change in structure	"It confirmed that heroin is expensive to buy. This seems to be reinforced" - the 1st exposure provides awareness of cost in general terms, though no evidence of specific amounts of cost, which is revealed in the exposure - though this is not identified, the impact is verification
S3	a	base -> 2	no change in structure	"even more so, because of what all the information said, I won't use heroin" indicates a strengthening of ideas: It is difficult to establish a particular structure to demonstrate this indicator; it is implied rather than made explicit.

GIRL #4

indicator	no.	level	cognitive strategy	change in knowledge structure
S1	a	base -> 1	appending	"you know for certain where before you might have thought something but weren't sure, such as where heroin comes from" Original ideas are repeated, and then elaborated on: a more general statement about where heroin comes from - seems to repeat idea by appending a more inclusive class

TABLE 29
INDICATORS OF
GET A POSITION IN A PICTURE FOR EACH GIRL

GET A POSITION IN A PICTURE
GIRL #1 Specific (S) S1 I was surprised that artists and poets used heroin. I didn't think that they would be able to think logically as it affects their brain cells. S2 It surprises me that they could get inspired by it S3 I agree that it is a valid way of removing users from the illegal drug scene
GIRL #2 General (G) G1 I'm able to make a conclusion, that is I can put all the ideas together and make a general statement G2 it helps you work out what you want for yourself G3 I can establish alternative views Specific (S) S1 gives me an argument eg heroin and pregnancy for girls who want to take heroin - I may be talking about this sometime with them, and can state my opinion based on a good argument S2 it caused a reaction eg. people harming their babies through heroin S3 I'm able to make some guesses. You make guesses about some possible facts. Like the effects S4 I can draw a conclusion eg heroin and driving S5 I can state a personal viewpoint, for example, like Coleridge S6 I feel that expensive fines and penalties do not effectively stop ... S7 I was surprised that cigarette smoking was more dangerous S8 it particularly emphasised the importance of the psychological dependence above everything else S9 I find that this is a better answer to heroin addiction, as it tries to .... S10 I understand her point when she says that extended families provide more support, but .... S11 but I feel that extended families for all is not a realistic goal or solution to the heroin problem S12 made me realise how important further drug education and prevention ... are to reducing the drug problem in general S13 it surprised me that Samuel Taylor Coleridge used it S14 the information said it was less harmful to your body than alcohol, which really surprised me S15 This is my opinion about the media

GET A POSITION IN A PICTURE

GIRL #3

General (G)

G1 enables me to build a stronger case. This is in my own mind that I won't take drugs
G2 you can comment on an idea with a bit more certainty, conviction. That's because you have more correct facts
G3 you can present a more accurate argument from your point of view

Specific (S)

S1 helps me express an opinion based on fact. When I got the facts on treatment, I could state which one I thought was best
S2 I was a bit shocked to find out that Coleridge was a heroin user. We are studying Coleridge and his poetry in English. ...I was surprised that it was used by someone with a profession as a writer. I'm sure he used it in moderation otherwise he couldn't create the poetry he wrote. It doesn't change my view of Coleridge as a writer

GIRL #4

General (G)

G1 You have the arguments you can use when you are discussing the drug with someone
G2 you can make comment on things - you've got enough information to express an opinion eg on various treatments

Specific (S)

S1 I can make comparisons because I've got more information, such as comparing heroin and alcohol, and work out what I think for me
S2 you can develop your own view where you stand in relation to an idea, like Coleridge

TABLE 30
SUMMARY OF CHANGES TO KNOWLEDGE STRUCTURES ASSOCIATED WITH PERCEIVED EFFECT GET *A POSITION IN A PICTURE*
note: indicators based on those in Table 29

GIRL #1

indicator	no.	level	cognitive strategy	change in knowledge structure
S1 / 2	a	base -> 1 -> 2	appending -> appending	"I was surprised that artists and poets used heroin". I didn't think that they would be able to think logically as it affects their concentration" and "it surprises me that they could get inspired by it": the perceived effect is stating a reaction in the form of a value judgement. It is built up by the 1st and 2nd exposures. The effect is brought about first by the appending of a large substructure about the history of heroin derived from the 1st exposure. Part of this substructure includes a sequence of propositions based on "it helped noted writers and artists" This node is expanded by identifying Samuel Taylor Coleridge as an opium user, and two nodes that identify how the use of opium helped: "opium enhanced creativity" and ""opium enhanced their perception of the world". The position statement "I find this surprising" is appended after the 2nd Exposure, and is based on the reason "because opium dulls the concentration" with the consequence "they are not able to think logically". The reason and consequence are facts derived from the 2nd exposure. The perceived effect, that of stating a position statement in the form of a reaction is brought on by the appending of information from the 1st and 2nd exposures. It is the result first of appending which leads to get a complete picture.

GIRL #1

indicator	no.	level	cognitive strategy	change in knowledge structure
S3	a	base ->3	appending -> appending	"I agree that it [methadone] is a valid way of removing users from the illegal drug scene" The position statement: "I agree that it is a valid way of removing users from the illegal drug scene" is brought about first by the building up of a set of facts about therapeutic communities". This set of facts includes the identification of a number of strengths and weaknesses of this form of treatment. Appended to the proposition: "addicts don't mix in the illegal drug scene" is the judgement "this is an important aspect of effective treatment". This node appears to bring on the agreement with therapeutic communities as a valid way of removing users from the illegal drug scene. The perceived effect comes through appending of facts to build up a complete picture, thus enabling the position statement to be derived.

GIRL #2

indicator	no.	level	cognitive strategy	change in knowledge structure
S1	a	base -> 2	no change	the perceived effect "gives me an argument eg heroin and pregnancy for girls who want to take heroin - I may be talking about this sometime with them, and can state my opinion based on a good argument" suggests that the exposure to information enables the construction of an argument which becomes a position statement for future use.
S2	a	base -> 2	appending	"I can't believe that people would do that to their babies" The perceived effect is a personal reaction to the information of the 2nd exposure, facts about the effect of heroin on pregnancy. The position statement "I cannot believe ..." is not one of denying or rejecting the facts, but a statement of amazement and astonishment because such an effect was unexpected. It is a reaction based on the respondent's notion of human nature and human decency. The perceived effect is brought on by the appending of facts to first build up a complete picture, from which the position statement is derived, and then appended. Appending -> get a complete picture -> appending of position statement.
S3	a	base -> 2	no change	"I'm able to make some guesses. You make guesses about some possible facts. Like the effects"
S4	a	base -> 2	appending	"I can draw a conclusion eg. heroin and driving" States her own circumstance with driving, and uses this circumstance to predict another potential impact of the effects - predictive change?

GIRL #2

indicator	no.	level	cognitive strategy	change in knowledge structure
S5 / 13	a	base -> 1	appending	"I can state a personal viewpoint, for example about Coleridge" and "it surprised me that Samuel Taylor Coleridge used it" Appended is a personal viewpoint: "seems strange that respected people would have taken it" plus reaction of surprise plus reason for surprise: "he seemed so natural"
S6	a	base -> 1	appending	"I feel that expensive fines and penalties do not effectively stop drug use" stating a conclusion derived from facts: appending of a set of personal statements which comment on "penalties". Viewpoint plus reasons for viewpoint provided
S7 / 14	a	1 -> 2	appending	"I was surprised that cigarette smoking was more dangerous" This is indicated in the structure by fact "it is less dangerous than cigarette smoking" and the comment that because they are legal, "social acceptance seems to hide the real danger" Extends fact by adding a personal reason "the information said it was less harmful to your body than alcohol, which really surprised me"
S8	a	base -> 2	appending appending	"it particularly emphasis the importance of the psychological dependence above everything else" This position statement is not reflected explicitly in the structures, but a reflection derived from changes to two substructures (case 6 & case 7) These structures present facts about psychological dependency, and are facts derived from the exposure to information.

GIRL #2

indicator	no.	level	cognitive strategy	change in knowledge structure
S9	a	base -> 3	appending	"I can make a judgement about forms of treatment, like, I do not feel that methadone is a real solution" and "I find that this [therapeutic communities] is a better answer to heroin addiction..." These are indicators of being able to derive personal conclusions from the sets of facts: The first judgement is appended as a personally stated conclusion, plus reasons for the viewpoint; the second: no evidence in the set of facts for the conclusion [remains potential]
S10 / 11	a	1 -> 3	appended	"I understand her point when she says that extended families provide more support, but I feel that extended families for all is not a realistic goal or solution to the heroin problem. Again, I'm able to make the point" Point is made through appending viewpoint plus reason
S12	a		this is appended in several places	"made me realise how important further drug education and prevention ... are to reducing the drug problem in general" This viewpoint is discussed in Verification
S15	a	base ->2	appending	opinion statement added

GIRL #3

indicator	no.	level	cognitive strategy	change in knowledge structure
S1	a	base -> 1 base -> 2	appending , inserting	"I'm able to look at heroin from different sides rather than having a narrow fixed view; see different viewpoints, from the legal side, from the addicts side" appended is a position statement ""I feel they should not be made available in the beginning" (based on initial statements, plus derived from 1st exposure on problems of addiction); inserting of reason for initial position that it should not be made legal (based on effects as elaborated in 2nd exposure)

GIRL #3

indicator	no.	level	cognitive strategy	change in knowledge structure
S1	b	base -> 3	appending	"Helps me express an opinion based on fact. When I got the facts on treatment I could state which one I found was best". This judgement is not expressed in the structure - there is building up a complete picture, but the expression is potential, rather than realised in the structure.
S2	a	base ->1	appending	"I was a bit shocked to find out that Coleridge was a heroin user, and the written information helps me form an opinion about that" The opinion is stated as "I'm sure he used it in moderation otherwise he couldn't create the poetry he wrote." and " It doesn't change my view of Coleridge as a writer" Reactive - defensive of original viewpoint on Coleridge; reinforce status quo

GIRL #4

indicator	no.	level	cognitive strategy	change in knowledge structure
S1	a	base - 1	appending	"I can make comparisons because I've got more information, such as comparing heroin and alcohol, and work out what I think for me"; append position - no outcome of comparing
S2	a	base -> 2	appending	you can develop your own view where you stand in relation to an idea, like Coleridge facts on effects lead to conclusion: "perhaps Coleridge would have written more colourful poetry if he hadn't taken the drug!"

BIBLIOGRAPHY

AITKENHEAD, A. & SLACK, J. Issues in cognitive modeling. London: Erlbaum in association with the Open University, 1985.

ALEXANDER, P. & JUDY, J. The interaction of domain-specific and strategic knowledge in academic performance. Review of Educational Research. 1988; 58(4), 375-404.

ALEXANDER, P., KULIKOWICH, J. & JETTON, T. The role of subject-matter knowledge and interest in processing of linear and nonlinear texts. Review of Educational Research. 1994; 64(2): 201-252.

ALLEN, B. Knowledge organization in an information retrieval task. Information Processing & Management. 1990; 26(4): 535-542.

ALLEN, B. Cognitive research in information science: implications for design. Annual Review of Information Science and Technology. 1991; 26: 3-37

ALLEN, B. Information needs: a person-in-situation approach. Paper presented at the Information Seeking in Context Conference, Department of Information Studies, University of Tampere, Finland, 14-16th August, 1996.

AMERICAN LIBRARY ASSOCIATION: Presidential Committee on Information Literacy. Final Report. Chicago: ALA, 1989.

ANDERSON, J. Language, memory, and thought. Hillsdale, N.J.: Lawrence Erlbaum Associates, 1976.

ANDERSON, J. The architecture of cognition. Cambridge, Ma.: Harvard University Press, 1983.

AUSUBEL, D. The psychology of meaningful verbal learning: an introduction to school learning. New York: Grune and Stratton, 1963.

AUSUBEL, D. Some psychological aspects of the structure of knowledge. In: S. Elam (ed.) Education and the structure of knowledge: Fifth Annual Phi Delta Kapp Symposium on Educational Research. Chicago: Rand McNally, 1969: 221-249.

AUSUBEL, D., NOVAK, J. & HANESIAN, H. Educational psychology: a cognitive view. 2nd ed. New York: Holt, Rinehart & Winston, 1987.

BACKER, T. Knowledge utilization: the third wave. Knowledge: Creation, Diffusion, Utilization. 1991; 12(3): 225-240.

BACKER, T. & SHAPERMAN, J. Knowledge utilization and foundations supporting health research demonstrations: initial explorations. Knowledge: Creation, Diffusion, Utilization. 1993; 14(4): 386-400.

BARAN, S. & DAVIS, D. Mass communication theory: foundations, ferment, and future. California: Wadsworth, 1995.

BARTLETT, F. Remembering: a study in experimental and social psychology. Cambridge: Cambridge University Press, 1932.

BEDELL, J., WARD, J., ARCHER, R. & STOKES, M. An Empirical Evaluation of a Model of Knowledge Utilization. Evaluation Review. 1985; 9(2): 109-126.

BELKIN, N. Linguistic and cognitive models of information and state of knowledge. Report to the British Library Research and Development Department on Project Number V/13. London: City University, 1976.

BELKIN, N. Internal knowledge and external information. In: M. De Mey (ed.) International workshop on the cognitive viewpoint. Ghent: University of Ghent, 1977, 214-218.

BELKIN, N. Progress in documentation: information concepts for information science. Journal of Documentation. 1978; 34(1): 55-85.

BELKIN, N. Cognitive models and information transfer. Social Science Information Studies. 1984; 4: 111-129.

BELKIN, N. The cognitive viewpoint in information science. Journal of Information Science. 1990; 16: 11-15.

BELKIN, N., BROOKS, H., & DANIELS, P. Knowledge elicitation using discourse analysis. International Journal of Man-Machine Studies. 1987; 27, 127-144.

BELKIN, N., ODDY, R. & BROOKS, H. ASK for information retrieval: Part 1. Background and theory. Journal of Documentation. 1982a; 38(2): 61-71.

BELKIN, N., ODDY, R. & BROOKS, H. ASK for information retrieval: Part 11: results of a design study. Journal of Documentation. 1982b; 38(3): 145-164.

BELKIN , N. & ROBERTSON , S. Information science and the phenomenon of information. Journal of the American Society for Information Science. 1976; 27(4); 197-204.

BERG, W. & THEADO, R. The utilization of evaluative research in social welfare programs. Social Service Review. 1981; 183-192.

BEYER, J. & TRICE, H. The utilisation process: a conceptual framework and synthesis of empirical findings. Administrative Science Quarterly. 1982; 27(4): 591-622.

BLACK, J. The effects of reading purpose on memory for texts. In: J. Long & A. Braddeley (eds.) Attention and performance IX. Hillsdale, N.J.: Erlbaum, 1981.

BLUMER, H. Methodological principles of empirical science. In: N. Denzin (ed.) Sociological methods. 3rd ed. Englewood Cliffs, N.J.: Prentice Hall, 1977: 29-44.

BOBROW, D. & COLLINS, A. (eds.) Representation and understanding: studies in cognitive science. New York: Academic Press, 1975.

BOGGS, J. Implicit models of social knowledge use. Knowledge: Creation, Diffusion, Utilization. 1992 Sep; 14(1): 29-62.

BOOTH, T. Researching policy research. Knowledge: Creation, Diffusion, Utilization. 1990 Sep; 12(1): 80-100.

BORG, W. & GALL, M. Educational research: an introduction. 4th ed. New York: Longman, 1983.

BORGMAN, C. The user's mental model of an information retrieval system: an experiment on a prototype online catalog. Man-Machine Studies. 1986; 24: 47-64.

BOULDING, K. The image. Ann Arbor, Mi.: University of Michigan Press, 1956.

BRENDLINGER, N. Influence of research methods on policy development: comparison of a survey and a sense-making study about Texans and AIDS. Ann Arbor, MI.: U.M.I. Dissertation Services, 1992.

BREWER, W. Schemas versus mental models in human memory. In: P. Morris (ed.) Modelling cognition. New York: John Wiley, 1987: 187-197.

BREWER, W. & TREYENS, J. Role of schemata in memory for place. Cognitive Psychology. 1981; 13: 207-230.

BROADBENT, M. Information management and educational pluralism. Education for Information. 1984; 2: 209-227.

BROOKES, B. Robert Fairthorne and the scope of information science. Journal of Documentation. 1974; 30(2): 139-152.

BROOKES, B. The fundamental problem of information science. In: V. Horsnell (ed.) Informatics 2: Proceedings of a conference held by the Aslib Co-ordinate Indexing Group; March 25 1974. Oxford: Aslib, 1975a: 42-49.

BROOKES. B. The fundamental equation of information science. In: Problem of information science. FID 530. Moscow, 1975b: 115-130.

BROOKES, B. A new paradigm for information science? The Information Scientist. 1976; 10(3): 103-111.

BROOKES, B. The developing cognitive viewpoint in information science. Journal of Informatics. 1977; 1: 55-61.

BROOKES, B. Informatics as the fundamental social science. In: P. Taylor. New Trends in Documentation and Information: Proceedings of the 39th FID Congress; September 25 1978. FID Publication 566. Edinburgh: Aslib, 1978: 19-29.

BROOKES, B. The foundations of information science. Part 1. Philosophical aspects. Journal of Information Science. 1980a; 2: 125-133.

BROOKES, B. The foundations of information science. Part 11. Quantitative aspects: classes of things and the challenge of human individuality. Journal of Information Science. 1980b; 2: 209-221.

BROOKES, B. The foundations of information science. Part 111. Quantitative aspects: objective maps and subjective landscapes. Journal of Information Science. 1980c; 2: 269-275.

BROOKES, B. Measurement in information science: objective and subjective metrical space. Journal of the American Society for Information Science. 1980d; 248-255.

BROOKES, B. The foundations of information science. Part IV. Information science: the changing paradigm. Journal of Information Science. 1981a; 3: 3-12.

BROOKES, B. Information technology and the science of information. In: R. Oddy, et al. (eds.) Information retrieval research. London: Butterworths, 1981b: 1-8.

BROOKES, B. Foundations of information science. Journal of Information Science. 1982; 5: 45-46.

BROOKES, B. Research in information science: a progress report. Journal of Information Science. 1983; 6: 51-57.

BROOKES, B. Popper's worlds. Journal of Information Science. 1984; 8: 39-40.

BROOKES, B. Jason Farradane and relational indexing. Journal of Information Science. 1986; 12: 15-18.

BUCHMANN, M. What is irrational about knowledge utilization. Curriculum Inquiry. 1985; 15(2): 153-168.

BUCKLAND, M. Information as thing. Journal of the American Society for Information Science. 1991; 42(5): 351-360.

BYRSKI, L. Pills, potions, people: understanding the drug problem. Melbourne: Dove Communications, 1986.

CAMPBELL, D. & STANLEY, J. Experimental and quasi-experimental design for research. Chicago: Rand McNally, 1963.

CARTER, R. A journalistic cybernetic. Conference on communication and control in social processes. Philadelphia, Pa.: University of Pennsylvania, October 31, 1974.

CARVER, R. Effect of prediction activities, prior knowledge, and text type upon amount comprehended: using rauding theory to critique schema theory research. Reading Research Quarterly. 1992; 27(2): 165-174.

CEIDA (CENTRE FOR EDUCATION AND INFORMATION ON DRUGS AND ALCOHOL) Drugs and the law. Sydney, 1990.

CEIDA (CENTRE FOR EDUCATION AND INFORMATION ON DRUGS AND ALCOHOL) Heroin: depressant. Sydney, 1990.

CERCONE, N. & MCCALLA, G. (eds.) The knowledge frontier: essays in the representation of knowledge. New York: Springer-Verlag, 1987.

CHATMAN, E. Diffusion theory: A review and test of a conceptual model in information diffusion. Journal of the American Society for Information Science. 1986; 37(6): 377-386.

CHI, M., HUTCHINSON, J. & ROBIN, A. How inferences about novel domain-related concepts can be constrained by structured knowledge. Merrill-Palmer Quarterly: Journal of Developmental Psychology. 1989; 35(1): 27-62.

CHI, M. & KOESKE, R. Network representation of a child's dinosaur knowledge. Developmental Psychology. 1983; 19(1): 29-39.

CLARK, A. Information use: a professional strategy. Human Relations. 1979; 32(6): 503-522.

COHEN, P. Modern social theory. London: Heinemann, 1975.

COLE, C. Operationalizing the notion of information as subjective construct. Journal of the American Society for Information Science. 1994; 45(7): 465-476.

COLLINS, A. & LOFTUS, E. A spreading activation theory of semantic processing. Psychological Review. 1975; 82: 407-428.

CONWAY, T. & WILSON, M. Psychological studies of knowledge representation. In: G. Ringland & D. Duce (eds.) Approaches to knowledge representation: an introduction. Taunton, U.K.: Research Studies Press, 1988: 117-160.

COOK, T., LEVINSON-ROSE, J. & POLLARD, W. The misutilization of evaluation research. Knowledge: Creation, Diffusion, Utilization. 1980; 1(4): 477-498.

COOK, T. & POLLARD, W. Guidelines: how to recognize and avoid some common problems of mis-utilization of evaluation research findings. Evaluation. 1977; 4: 161-164.

COURSEY, D. Using experiments in knowledge utilization in research. Knowledge: Creation, Diffusion, Utilization. 1989; 10(3): 224-238.

COUSINS, J. & LEITHWOOD, K. Current empirical research on evaluation utilization. Review of Educational Research. 1986; 56(3): 331-364.

COUSINS, J. & LEITHWOOD, K. Enhancing knowledge utilization as a strategy for school improvement. Knowledge: Creation, Diffusion, Utilization. 1993; 14(3): 305-333.

CRAIK, K. The nature of explanation. London: Cambridge University Press, 1943.

CRATON, L. et al. Children's use of frames of reference in communication of spatial location. Child Development. 1990; 61: 1528-1543.

DAVALOS, S. Knowledge-structured information systems for understanding: an architecture and an implementation. Ann Arbor, Mi.: U.M.I. Dissertation Services, 1992.

DAVID, S. Developing a technology transfer program for the National Institute on Drug Abuse. Knowledge: Creation, Diffusion, Utilization. 1991; 12(3): 289-297.

DE MARTINI, J. & WHITBECK, L. Knowledge use as knowledge creation: reexamining the contribution of the social sciences to decision making. Knowledge: Creation, Diffusion, Utilization. 1986; 7(4): 383-396.

DE MEY, M. The cognitive viewpoint: its development and its scope. In: M. De Mey (ed.) International workshop on the cognitive viewpoint. March 24-26, 1977 in Ghent, Belgium. Ghent: University of Ghent, 1977: xvi-xxxii.

DE MEY, M. The relevance of the cognitive paradigm for information science. In: O. Harbo & L. Kajberg (eds.) Theory and application of information research: Proceedings of the Second International Research Forum on Information Science, 3-6 August 1977, Copenhagen. London: Mansell, 1980: 48-61.

DE MEY, M. The cognitive paradigm. Dordrecht: Reidel, 1982.

DE MEY, M. Cognitive science and science dynamics. Philosophical and epistemological issues for information science. Social Science Information Studies. 1984; 4: 97-110.

DEBONS, A. The measurement of knowledge. In: D. Shaw, (ed.) ASIS '92: proceedings of the 55th ASIS Annual Meeting; October 26 1992. Pittsburgh, Pa.: Learned Information, 1992: 29-31.

DENZIN, N. The research act: a theoretical introduction to sociological methods. 3rd ed. Englewood Cliffs, N.J.: Prentice Hall, 1989.

DERVIN, B. An overview of sense-making research: concepts, methods and results to date. Paper presented at the International Communication Association annual general meeting. Dallas, 1983a.

DERVIN, B. Information as a user construct: the relevance of perceived information needs to synthesis and interpretation. In: A. Ward & L. Reed (eds.) Knowledge structure and use: implications for synthesis and interpretation. Philadelphia: Temple University Press, 1983b: 155-183.

DERVIN, B. Users as research inventions: how research categories perpetuate inequities. Journal of Communication. 1989; 39(3): 216-232.

DERVIN, B. Comparative theory reconceptualized: from entities and states to processes and dynamics. Community Theory. 1991; 1(1): 59-69.

DERVIN, B. From the Mind's Eye of the User: the sense-Making qualitative-quantitative methodology. In: J. Glazier & R. Powell. Qualitative research in information management. Englewood, Co.: Libraries Unlimited, 1992: 61-84.

DERVIN, B. Information <-> democracy: an examination of underlying assumptions. Journal of the American Society for Information Science. 1994; 45(6): 369-385.

DERVIN, B. Given a context by any other name: methodological tools for taming the unruly beast. Paper presented at the Information Seeking in

Context Conference, Department of Information Studies, University of Tampere, Finland, 14-16th August, 1996.

DERVIN, B. et al. How libraries help. Stockton, Ca.: University of the Pacific, 1985.

DERVIN, B. & DEWDNEY, P. Neutral questioning: a new approach to the reference interview. RQ. 1986; 25(4): 506-513.

DERVIN, B., HARLOCK, S., ATWOOD, R., & GARZONA, C. The human side of information: an exploration in a health communication context. Communication Yearbook. 1986, 4: 591-608.

DERVIN, B. & NILAN, M. Information needs and uses. Annual Review of Information Science and Technology. 1986; 21: 3-33.

DESHPANDE, R. & KOHLI, A. Knowledge disavowal: structural determinants of information-processing breakdown in organizations. Knowledge: Creation, Diffusion, Utilization. 1989; 11(2): 155-169.

DICKMAN, F. Work activities, settings, methodologies, and perceptions: correlates of evaluative research utilization. Knowledge: Creation, Diffusion, Utilization. 1981; 2(3): 375-388.

DUNN, W. The Two-Communities Metaphor and models of knowledge use: an exploratory case study. Knowledge: Creation, Diffusion, Utilization. 1980; 1(4): 515-536.

DUNN, W. Measuring knowledge use. Knowledge: Creation, Diffusion, Utilization. 1983a; 5(1): 120-133.

DUNN, W. Qualitative methodology. Knowledge: Creation, Diffusion, Utilization. 1983b; 4(4): 590-597.

DUNN, W., DUKES, M. & CAHILL, A. Designing utilization research. Knowledge: Creation, Diffusion, Utilization. 1984; 5(3): 387-404.

DUNN, W. & HOLZNER, B. Knowledge in society: anatomy of an emergent field. Knowledge in Society. 1988; 1: 3-26.

DUNN, W., HOLZNER, B., SHAHIDULLAH, M. & HEGEDUS, A. The architecture of knowledge systems: toward policy-relevant science impact indicators. Knowledge: Creation, Diffusion, Utilization. 1987; 9(2): 205-232.

DUNN, W., HOLZNER, B. & ZALTMAN, G. Knowledge utilization. In: T. Husen & T. Postlethwaite(eds.) International Encyclopedia of Education. New York: Pergamom, 1985: 2831-2839.

EDWARDS, S. & POSTON-ANDERSON, B. Information needs and life concerns of Australian adolescent girls. Youth Studies Australia. 1993: 34-37.

ERLANDSON, D. et al. Doing naturalistic inquiry: a guide to methods. Newbury Park, Ca.: Sage, 1993.

FARAG, Z. Gaps in the dissemination/knowledge utilization base. Knowledge: Creation, Diffusion ,Utilization. 1991; 12(3): 266-288.

FARRADANE, J. A scientific theory of classification: further considerations. Journal of Documentation. 1952; 8: 73-92.

FARRADANE, J. Concept organization for information retrieval. Information Storage and Retrieval. 1967; 3: 297-314.

FARRADANE, J. Toward a true information science. Information Scientist. 1976; 10(3): 91-101.

FARRADANE, J. The nature of information. Journal of Information Science. 1979; 1: 13-17.

FARRADANE, J. Relational indexing. Part 1. Journal of Information Science. 1980a; 1: 267-276.

FARRADANE, J. Relational indexing. Part 2. Journal of Information Science. 1980b; 1: 313-324.

FARRADANE, J. A scientific theory of classification and indexing and its practical applications. Journal of Documentation. 1980c; 6(2): 83-99.

FARRADANE, J. Knowledge, information, and information science. Journal of Information Science. 1980d; 2: 75-80.

FELDMAN, M. & MARCH, J. Information organizations as signal and symbol. Administrative Science Quarterly. 1981; 26: 171-186.

FINE, S. Research and the psychology of information use. Library Trends. 1984; 441-460.

FLETCHER, T. An examination of situational dimensions in the information behaviors of general managers. Ann Arbor, Mi.: U.M.I. Dissertation Services, 1991.

FLORIO, E. & DEMARTINI, J. The use of information by policymakers at the local community level. Knowledge: Creation, Diffusion, Utilization. 1993; 15(1): 106-123.

FREDERIKSEN, C. Effects of task-induced cognitive operations on comprehension and memory processes. In: R. Freedle & J. Carroll, (eds.) Language comprehension and the acquisition of knowledge. Washington, D.C.: Winston, 1972: 211-245.

FREDERIKSEN, C. Acquisition of semantic information from discourse: effects of repeated exposures. Journal of Verbal Learning and Verbal Behavior. 1975a; 14: 158-169.

FREDERIKSEN, C. Effects of context-induced processing operations on semantic information acquired from discourse. Cognitive Psychology. 1975b; 7: 139-166.

FREDERIKSEN, C. Representing logical and semantic structure of knowledge acquired from discourse. Cognitive Psychology. 1975c; 7: 371-458.

FRIEDMAN, M. & FARAG, Z. Gaps in the dissemination/knowledge utilisation base. Knowledge: Creation, Diffusion, Utilization. 1991; 12(3): 266-288.

FROHMANN, B. The power of images: a discourse analysis of the cognitive viewpoint. Journal of Documentation. 1992; 48(4): 365-386.

GAINES, B. An overview of knowledge-acquisition and transfer. International Journal of Man-Machine Studies. 1987; 26: 453-472.

GLASER, B. & STRAUSS, A. The discovery of grounded theory: strategies for qualitative research. Chicago: Aldine, 1967.

GLASS, G., WILSON, V. & GOTTMAN, J. Design and analysis of time-series experiments. Boulder, Co.: Colorado Associated Press, 1975.

GOBBO, C. & CHI, M. How knowledge is structured and used by expert and novice children. Cognitive development. 1986; 1: 221-237.

GOFFMAN, E. The presentation of self in everyday life. Woodstock, N.Y.: Overlook Press, 1973.

GONOS, G. "Situation" versus "frame": the "interactionist" and the "structuralist analyses of everyday life. American Sociological Review. 1977 Dec; 42: 854-867.

GORDON, S. Implications of cognitive theory for knowledge acquisition. In: R. HOFFMAN (ed.) The psychology of expertise: cognitive research and experimental AI. New York: Springer-Verlag, 1992: 99-120.

GRAESSER, A. Prose comprehension beyond the word. New York: Springer-Verlag, 1981.

GRAESSER, A. & BLACK, J. (eds.) The psychology of questions. Hillsdale, N.J.: Erlbaum, 1985.

GRAESSER, A. & CLARK, L. Structures and procedures of implicit knowledge. Norwood, N.J.: Ablex, 1985.

GRAESSER, A., LANG, K. & HORGAN, D. A taxonomy for question generation. Questioning Exchange. 1988; 2(1): 3-15.

GRAESSER, A. & MURRAY, K. A question-answering methodology for exploring a user's acquisition and knowledge of a computer environment. In: S. Robertson, W. Zachary, & J. Black. (eds.) Cognition, computing and cooperation. Norwood, N.J.: Ablex, 1989: 237-267.

GRAESSER, A., ROBERTSON, S. & ANDERSON, P. Incorporating inferences in narrative representations: a study of how and why. Cognitive Psychology. 1981; 13: 1-26.

GREEN, R. The profession's models of information: a cognitive linguistic analysis. Journal of Documentation. 1991; 47(2): 130-148.

GREEN, J. & McCLINTOCK, C. Triangulation in evaluation: design and analysis issues. Evaluation Review. 1985; 9(5): 523-545.

GROVER, R. & GLAZIER, J. A conceptual framework for theory building in library and information science. LISR. 1986; 8: 227-242.

GUBA, E. & LINCOLN, Y. Fourth generation evaluation. Newbury Park, Ca.: Sage, 1989.

GWIAZDA, A. Socially useful research - knowledge of dubious value? Some remarks about the quality of knowledge and the relationship between scientist and policy-maker. Knowledge: Creation, Diffusion, Utilization. 1983; 5(2): 233-244.

HAAG, D. Barriers limiting the usefulness of published information in the research environment. Special Libraries. 1984: 214-220.

HALL, H. Patterns in the use of information: the right to be different. Journal of the American Society for Information Science. 1981: 103-112.

HALL, G., GEORGE, A. & RUTHERFORD, W. Measuring stages of concern about the innovation: a manual for use of the SoC Questionnaire. Austin, Texas: Southwest Educational Development Library (SEDL), 1986.

HALL, G. & LOUCKS, S. A developmental model for determining whether the treatment is actually implemented. American Educational Research Journal. 1977; 14(3): 263-276.

HALL, G., LOUCKS, S., RUTHERFORD, W. & NEWLOVE, B. Levels of use of the innovation: A framework for analyzing innovation adoption. Journal of Teacher Education. 1975; xxvi(1): 52-56.

HALLIDAY, M. & HASAN, R. Language, context and text: aspects of language in a social-semiotic perspective. Melbourne: Deakin University Press, 1985.

HAMMARBERG, R. The cooked and the raw. Journal of Information Science. 1981; 3: 261-267.

HARB, O. & KAJBERG, L. (eds.) Theory and application of information research. Proceedings of the Second International Research Forum on Information Science. London: Mansell, 1980.

HARDY, A. The selection of channels when seeking information: cost-benefit vs least-effort. Information Processing & Management. 1982; 18(6): 289-293.

HARMON, S. On the nature of exploratory behavior in hypermedia environments: considerations of learner use patterns of hypermedia environments for learning. Ann Arbor, Mi.: U.M.I. Dissertation Services, 1992.

HASHWAY, R. & HASHWAY, S. Solving mathematical word problems: integrating frames of reference and world models. Forum For Reading. 1990; 21(2): 32-38.

HAYES, P. The logic of frames. In: D. Metzing (ed.) Frame conceptions and text understanding. Berlin: Walter de Gruyter, 1980: 46-61.

HEILPRIN, L. Foundations of information science reexamined. Annual Review of Information Science and Technology. 1989; 24: 343-372.

HENSHAW, A. "Are You a Good Reader Now?": Secondary school remedial readers perceptions of their own reading ability and their frames of reference for "good" and "poor" readers. Reading. 1991, 25(2): 17-25.

HEWINS, E. Information needs and use studies. Annual Review of Information Science and Technology. 1990, 20: 145-172.

HOFFMAN, R. The problem of extracting the knowledge of experts from the perspective of experimental psychology. AI Magazine. 1978; 8(2); 53-64.

HOFFMAN, R. A survey of methods for eliciting the knowledge of experts. In: K. McGraw & C. Wetphal (eds.) Readings in knowledge acquisition: current practices and trends. New York: Ellis Horwood, 1990: 7-20.

HOFFMAN, R. (ed.) The psychology of expertise: cognitive research and experimental AI. New York: Springer-Verlag, 1992.

HOLZNER, B. & FISHER, E. Knowledge in use: considerations in the sociology of knowledge application. Knowledge: Creation, Diffusion, Utilization. 1979; 1(2): 219-244.

HOLZNER, B. & MARX, J. Knowledge application: a knowledge system of society. Wellesley, Ma.: Allyn and Bacon, 1978.

HUBERMAN, M. Recipes for busy kitchens: a situational analysis of routine knowledge use in schools. Knowledge: Creation, Diffusion, Utilization. 1983; 4(4): 478-510.

HUBERMAN, M. Steps toward an integrated model of research utilization. Knowledge: Creation, Diffusion, Utilization. 1987; 8(4): 586-611.

HULTMAN, G. & HORBERG, C. Teachers' informal rationality. Science Communication. 1995; 16(3); 341-354.

HUTCHINSON, J. A multimethod analysis of knowledge use in social policy: research use in decisions affecting the welfare of children. Science Communication. 1995; 17(1); 90-106.

INGWERSEN, P. Search procedures in the library - analysed from the cognitive point of view. Journal of Documentation. 1982; 38(3): 165-191.

INGWERSEN, P. Psychological aspects of information retrieval. Social Science Information Studies. 1984a; 4: 83-95.

INGWERSEN, P. A cognitive view of three selected online search facilities. Online Review. 1984b; 8(5): 465-492.

INGWERSEN, P. Cognitive analysis and the role of the intermediary in information retrieval. In: R. Davies (ed.) Intelligent information systems: progress and prospects. Chichester: Ellis Horwood, 1986: 206-237.

INGWERSEN, P. Conceptions of information science. In: P. Vakkari & B. Cronin (eds.) Conceptions of library and information science: historical, empirical and theoretical perspectives. London: Taylor Graham, 1992a: 299-312.

INGWERSEN, P. Information retrieval interaction. London: Taylor Graham, 1992b.

INGWERSEN, P. Polyrepresentation of information needs and semantic entities. In: W. Croft & C. Van Rijsbergen (eds.) SIGIR '94: Proceedings of the seventeenth Annual International ACM-SIGIR Conference on Research

and Development in Information Retrieval 1994. London: Springer-Verlag, 1994: 101-110.

JOHNSON, K. Stimulating Evaluation Use by Integrating Academia and Practice. Knowledge: Creation, Diffusion, Utilization. 1980; 2(2): 237-262.

JONES, E. The value of research assignments. Scan. 1996; 15(3): 45-48.

KARAPIN, R. What is the use of social science? A review of the literature. In: F. Heller (ed.) The use and abuse of social science. London: Sage, 1986: 236-265.

KATSUNO, H. & MENDELZON, A. On the difference between updating a knowledge base and revising it. In: J. Allen, R. Fikes & E. Sandewall (eds.) Principles of knowledge representation and reasoning. Proceedings of the second international conference. San Mateo, Ca.: Kaufmann, 1991: 387-394.

KENNEDY, M. Working knowledge. Knowledge: Creation, Diffusion, Utilization. 1983; 5(2): 193-221.

KENNEDY, M. How evidence alter understanding and decisions. Educational Analysis and Policy Analysis. 1984; 6(3): 207-226.

KERR, D. Knowledge utilization. Knowledge: Creation, Diffusion, Utilization. 1981; 2(4): 483-501.

KINTSCH, W. The representation of meaning in memory. Hillsdale, N.J.: Erlbaum, 1974.

KINTSCH, W. & VAN DIJK, T. Toward a model of text comprehension and production. Psychological Review. 1978; 85(5): 363-394.

KIRK, J., POSTON-ANDERSON, B. & YERBURY, H. Into the 21st century: library and information services in schools. Sydney: ALIA, 1990.

KLEIN, J. The evolution of a body of knowledge: interdisciplinary problem-focused research. Knowledge: Creation, Diffusion, Utilization. 1985; 7(2): 117-142.

KLEINMUTZ, D. Cognitive heuristics and feedback in a dynamic decision environment. Management Science. 1985; 31(6): 680-702.

KRIKELAS, J. Information seeking behaviour and concepts. Drexel Library. 1983; 19(2): 5-20.

KRUYTBOSCH, C. & BURTON, L. The search for impact indicators. Knowledge: Creation, Diffusion, Utilization. 1987; 9(2): 168-172.

KUHLTHAU, C. Seeking meaning: a process approach to library and information services. Norwood, N.J.: Ablex, 1993.

KWASNIK, B. The importance of factors that are not document attributes in the organisation of personal documents. Journal of Documentation. 1991; 47(4): 389-398.

LACHMAN, R., LACHMAN, J. & BUTTERFIELD, E. Cognitive psychology and information processing: an introduction. Hillsdale, N.J.: Erlbaum, 1979.

LANTZ, A. The study of barriers affecting the process of information utilization: an investigation of the information situation of managers from small- and medium-sized companies. A framework. Social Science Information Studies. 1984; 4: 205-216.

LARSEN, J. Consultation and it outcome: Community Mental health Centers. Palo Alto, Ca.: American Institute for Research, 1976.

LARSEN, J. Knowledge utilization: what is it? Knowledge: Creation, Diffusion, Utilization. 1980; 1(3): 421-442.

LARSEN, J. Knowledge utilisation: current issues. In: R. Rich (ed.) The knowledge cycle. Beverly Hills, Ca.: Sage, 1981: 149-167.

LARSEN, J. Information utilization and non-utilization. Palo Alto, Ca.: American Institute for Research in the Behavioral Sciences, 1982.

LARSEN, J. Effect of time on information utilization. Knowledge: Creation, Diffusion, Utilization. 1985; 7(2): 143-159.

LARSEN, J. & AGARWALDA-ROGERS, R. The appropriateness of adaptation in the transfer of innovations. Re-invention of innovative ideas: modified? adopted? None of the above? Evaluation. 1977; 4: 136-140.

LAZARSFELD, P. & REITZ, J. An Introduction to Applied Sociology. New York: Elsevier Scientific Publishing, 1975.

LECOMPTE, M. & GOETZ, J. Problems of reliability and validity in ethnographic research. Journal of Educational Research. 1982; 52(1): 31-60.

LEVITON, L. & HUGHES, E. Research on the utilization of evaluations. Evaluation Review. 1981; 5(4): 525-548.

LINCOLN, Y. & GUBA, E. Naturalistic inquiry. Newbury Park, Ca.: Sage, 1985.

LINDLOF, T. Qualitative communication research methods. Thousand Oaks, Ca.: Sage, 1995.

LINDSAY, P. & NORMAN, D. Human information processing: an introduction to psychology. New York: Academic Press, 1977.

MAC RANDAL, D. Semantic networks. In: G. Ringland & D. Duce (eds.) Approaches to knowledge representation: an introduction. Taunton, U.K.: Research Studies Press, 1988: 45-79.

MACHLUP, F. Uses, value, and benefits of knowledge. Knowledge: Creation, Diffusion, Utilization. 1979; 1(1): 62-81.

MACHLUP, F. Knowledge: its creation, distribution, and economic significance. Volume 1: Knowledge and knowledge production. Princeton, N.J.: Princeton University Press, 1980.

MACKAY, D. Information, mechanism and meaning. Cambridge, Ma.: The M.I.T. Press; 1969.

MAKKAI, T. & MCALLISTER, I. Knowledge and information about drugs in Australia. Journal of Drug Education. 1990; 20(4): 337-352.

MANDELL, M. Simulation models and the study of information utilization in public-sector decision making. Knowledge: Creation, Diffusion, Utilization. 1989; 10(3): 202-214.

MANDELL, M. & SAUTER, V. Approaches to the study of information utilization in public agencies: problems and pitfalls. Knowledge: Creation, Diffusion, Utilization. 1984; 6(2): 145-164.

MARICIC, S. Information science as interfaces of the cognitive sphere and society. Information Processing & Management. 1987; 23(1): 33-43.

MARSH, H. Influences of internal and external frames of reference on the formation of math and english self-concepts. Journal of Educational Psychology. 1990; 82(1): 107-116.

MARSHALL, C. & ROSSMAN, G. Designing qualitative research. Newbury Park, Ca.: Sage, 1989.

MASSON, M. Cognitive processes in skimming stories. Journal of Experimental Psychology: Learning, Memory and Cognition. 1982; 8: 400-417.

MAY, P. et al. As others see it: a preliminary exploratory study of valuations placed on the perceived goals and benefits of different types of research endeavour. Knowledge: Creation, Diffusion, Utilization. 1983; 5(1): 26-40.

MAYTON II, D., NAGEL, E. & PARKER, R. The perceived effects of drug messages on use patterns in adolescents. Journal of Drug Education. 1990; 20(4): 305-318.

MCLAUGHLIN, G. & MCLAUGHLIN, J. Barriers to information use: the organizational context. New Directions for Institution and Research. 1989; 16(4): 21-33.

MERRILL, M., ZHONGMIN L. & JONES, M. Instructional transaction shells: responsibilities, methods, and parameters. Educational Technology. 1992; 5-26.

MILES, M. & HUBERMAN, A. Qualitative data analysis: a sourcebook of new methods. Newbury Park, Ca.: Sage, 1984.

MINSKY, M. A framework for representing knowledge. In: P. Winston (ed.) The psychology of computer vision. New York: McGraw-Hill, 1975: 211-277.

MURACHVER, T., MURRAY, K. & GRAESSER, A. Answering some questions about a model of question answering. In: A. Graesser & J. Black (eds.) The psychology of questions. Hillsdale, N.J.: Erlbaum, 1985.

NAGLE, T. et al. (eds.) Conceptual structures: current research and practice. New York: Ellis Horwood, 1992.

NEBEL, B. Belief revision and default reasoning: syntax-based approaches. In: J. Allen, R. Fikes & E. Sandewall (eds.) Principles of knowledge representation and reasoning. Proceedings of the second international conference. San Mateo, Ca.: Kaufmann, 1991: 417-428.

NEILL, S. Brookes, Popper, and objective knowledge. Journal of information Science. 1982; 4: 33-39.

NEISSER, U. Cognition and reality. San Francisco: W.H. Freeman, 1976.

NEW SOUTH WALES HEALTH DEPARTMENT: DRUG AND ALCOHOL DIRECTORATE. Drug caused deaths in NSW. Statistical Bulletin. 1993; 1: 1-4.

NEWBY, G., NILAN, M. & DUVALL, L. Toward a reassessment of individual differences for information systems: the power of user-based situational predictors. In: Proceedings of the 54th ASIS Annual Meeting; October 27; Washington D.C. ; 28: 73-81.

NITECKI, J. The concept of information-knowledge continuum: implications for librarianship. Journal of Library History. 1985; 20(4): 387-407.

NORMAN, D. Some observations on mental models. In: D. Gentner & A. Stevens (eds.) Mental models. Hillsdale, N.J.: Erlbaum, 1983: 7-14.

NORMAN, D. & RUMELHART, D. Explorations in cognition. San Francisco: Freeman, 1975.

NOVAK, J. Application of advances in learning theory and philosophy of science to the improvement of higher education. HERDSA News. 1985; 7(1): 7-14.

NOVAK, J. Human constructivism: a unification of psychological and epistemological phenomena in meaning making. International Journal of Personal Construct Psychology. 1993; 6: 167-193.

NOVAK, J. & GOWIN, B. Learning how to learn. Cambridge: Cambridge University Press, 1984: 1-55.

ODDY, R. et al. Towards the use of situational analysis in information retrieval. Journal of Documentation. 1992; 48(2): 123-171.

ODDY, R. Information retrieval through man-machine dialogue. Journal of Documentation. 1977; 33(1), 1-14.

ODEN, G. Concept, knowledge, and thought. Annual Review of Psychology. 1987; 38: 203-227.

OLSON, G., DUFFY, S. & MACK, R. Thinking-out-loud as a method for studying real-time comprehension processes. In: D. Kieras & M. Just (eds.) New methods in the study of immediate processes in comprehension. Hillsdale, N.J.: Erlbaum, 1984.

OTTEN, K. Basis for a science of information. In: A. Debons (ed.) Information science: search for identify. New York: Marcel Dekker, 1974: 91-106.

OWEN, D. Users in the real world. In: User centered system design. Part II. Collected papers from the UCSDF HMI project. San Deigo: Institute for Cognitive Science, University of California, 1984: 31-38.

OWEN, J. Forms of communicated knowledge and their effects on Australian teachers. Studies in Educational Evaluation. 1983; 9: 327-341.

OWEN, J., LAMBERT, F. & STRINGER, W. Acquiring knowledge of implementation and change: essential for program evaluators? Knowledge: Creation, Diffusion, Utilization. 1994; 15(3): 273-284.

PARSONS, T. Action theory and the human condition. New York: Free Press, 1978.

PARSONS, T. The Social System. London: Routledge & Kegan Paul, 1951.

PATTON et al. In search of impact: an analysis of federal health evaluation research. In: C. Weiss (ed.) Using social research in public policy making. Lexington, Ma.: Heath, 1977.

PELZ, D. Some expanded perspectives on use of social science in public policy. In: M. Yinger & S. Cutler (eds.) Major social issues: a multidisciplinary view. New York: Free Press, 1978: 346-357.

PELZ, D. & HORZLEY, J. Measuring utilization of nursing research. In: J. Ciarlo (ed.) Utilizing evaluation: concepts and measurement techniques. Beverly Hills, Ca.: Sage, 1981.

PESHKIN, A. The goodness of qualitative research. Educational Researcher. 1993; 23-29.

PIAGET, J. The theory of stages in cognitive development. In: D. Green, M. Ford, & G. Flame (eds.) Measurement and Piaget. New York: McGraw-Hill, 1971.

PINTRICH, P., MARX, R. & BOYLE, R. Beyond cold conceptual change: the role of motivational beliefs and classroom contextual factors in the process of conceptual change. Review of Educational Research. 1993; 63(2), 167-199.

POPPER, K. Objective knowledge: an evolutionary approach. Oxford: Clarendon Press, 1972.

PORN, I. Action theory and social science: some formal models. Holland: D. Reidel Publishing Company, 1977.

PRATT, J. Information and emmorphosis: an attempt at definition. In: O. Harbo & L. Kajberg (eds.) Theory and application of information research: Proceedings of the Second International Research Forum on Information Science, 3-6 August 1977, Copenhagen. London: Mansell, 1980: 30-33.

PRATT, J. Post-cognitive structure: its determinants and relationship to perceived information use and predictive accuracy. Journal of Accounting Research. 1982; 20(1): 189-209.

PREECE, P. Mapping cognitive structure: a comparison of methods. Journal of Educational Psychology. 1976; 68(1): 1-8.

PROPP, K. Information acceptance and utilization in small group decision-making: a study of the evaluative interaction model. Ann Arbor, Mi.: University Microfilms, 1993.

PRÖPPER, I. Sound arguments and power in evaluation research and policy-making: a measuring instrument and Its application. Knowledge: Creation, Diffusion, Utilization. 1993; 15(1): 78-105.

QUILLIAN, M. Semantic memory. In: M. Minsky (ed.) Semantic information processing. Boston: MIT Press, 1966: 227-270.

RAFTER, D. Three approaches to evaluation research. Knowledge: Creation, Diffusion, Utilization. 1984; 6(2): 165-185.

RAVETZ, J. Usable Knowledge, Usable Ignorance. Knowledge: Creation, Diffusion, Utilization. 1987; 9(1): 87-116.

REGOCZEI, S. & HIRST, G. What is meant by knowledge? In: R. Hoffman. (ed.) The psychology of expertise: cognitive research and experimental AI. New York: Springer-Verlag, 1992.

RICH, R. Selective utilization of social science related information by federal policymakers. Inquiry. 1975; 13(3): 72-81.

RICH, R. Uses of social science information by federal bureaucrats: knowledge for action versus knowledge for understanding. In: C. Weiss (ed.) Using social research in public policy making. Lexington: Lexington Books, 1977: 199-211.

RICH, R. Knowledge creation, diffusion, and utilization: perspectives of the Founding Editor of Knowledge. Knowledge: Creation, Diffusion Utilization. 1991; 12(3): 319-337.

RINGLAND, G. Structured object representation: schemata and frames. In: G. Ringland, G. & D. Duce (eds.) Approaches to knowledge representation: an introduction. Taunton, U.K.: Research Studies Press, 1988: 81-99.

ROBERTS, N. Social considerations towards a definition of information science. Journal of Documentation. 1976; 23(4): 249-257.

ROBERTS, R. & AMAN, C. Developmental differences in giving directions: spatial frames of reference and mental rotation. Child Development. 1963; 64: 1258-1270.

ROBERTSON, S. Brookes and information science education: a personal note. Journal of Information Science. 1990; 16: 9-19.

ROGERS, E. Diffusion of innovation. 3rd ed. New York: Free Press, 1983.

RORVIG, M. An experiment in human preferences for documents in a simulated information environment. Ann Arbor, Mi.: University Microfilms International, 1985.

ROSCH, E. & MERVIS, C. Family resemblances: studies in the internal structure of categories. Cognitive Psychology. 1975; 7: 573-605.

RUMELHART, D. Introduction to human information processing. New York: Wiley, 1977.

RUMELHART, D. Schemata and the cognitive system. In: R. Wyer & T. Srull (eds.) Handbook of Social Cognition. Hillsdale, N.J.: Erlbaum, 1984: 161-188.

RUMELHART, D., LINDSAY, P. & NORMAN, D. A process model for long-term memory. In: E. Tulving & W. Donaldson (eds.) Organisation of memory. New York: Academic Press, 1972: 198-248.

RUMELHART, D. & NORMAN, D. Representation of knowledge. In: A. Aitkenhead & J. Slack (eds.) Issues in cognitive modeling. London: Erlbaum in association with the Open University, 1985: 15-62.

RUSSELL, B. Human knowledge: its scope and limitations. London: George Allen & Unwin, 1948.

RYBASH, J., RODDIN, P. & HOYER, W. Adult development and aging. 3rd ed. Madison, Wi.: Brown & Benchmark, 1995.

SADOWSKY, D. & KUNZEL, C. Acquisition of knowledge about an innovation in patient management: impact of dentists' attitudes and orientations. Knowledge: Creation, Diffusion, Utilization. 1986; 7(3): 291-302.

SALASIN, S. Introduction: knowledge utilization as a social reform strategy - A new generation of challenges. Knowledge: Creation, Diffusion, Utilization. 1986; 8(2): 191-196.

SARACEVIC, T. & WOOD, J. Consolidation of information: a handbook on evaluation, restructuring and repackaging of scientific and technical information. Paris: General Information Programme and UNISIST of UNESCO, 1981.

SAVAGE, S. The theories of Talcott Parsons: the social relations of action. London: Macmillan, 1981.

SAVOLAINEN, R. The sense-making theory: reviewing the interests of a user-centered approach to information seeking and use. Information Processing & Management. 1993; 29(1): 13-28.

SAVOLAINEN, R. Everyday life information seeking: approaching information seeking in the context of "Way of Life". LISR. 1995; 17: 259-294.

SCARPINO, G., DUNN, W. & MITROFF, I. Knowledge acquisition for policymaking: the role of conceptual models. Knowledge: Creation, Diffusion, Utilization. 1983; 4(3): 335-355.

SCHANK, R. Conceptual information processing. Amsterdam: North-Holland Publishing Company, 1975.

SCHANK, R. Language and memory. Cognitive Science. 1980; 4: 243-284.

SCHANK, R. Language and memory. In: D. Norman (ed.) Perspectives on cognitive science. Norwood, N.J.: Ablex, 1981.

SCHANK, R. & ABELSON, R. Scripts, plans, goals, and understanding. Hillsdale, N.J.: Erlbaum, 1977.

SCHERVISH, P. Information use by levels in human service organizations. Urbana-Champaign: University of Illinois; 1989.

SCHLIEPER, A. A note on frames of reference in the assessment of learning disabilities. Journal of Learning Disabilities. 1982 ; 15(2): 84-85.

SHAW, A. B. C. Brookes and the development of information science: a bibliography. Journal of Information Science. 1990; 16: 3-7.

SHREIDER, Y. On the semantic characteristics of information. Information Storage and Retrieval. 1965; 2: 221-233.

SHUELL, T. Phases of meaningful learning. Review of Educational Research. 1990; 60(4): 531-547.

SLAMECKA, V. Pragmatic observations on theoretical research in information science. Journal of the American Society of Information Science. 1975; 26: 318-320.

SLAPPENDEL, C. Knowledge use versus capability development. Science Communication. 1994, 16(2): 195-205.

SMYTH, M. & KENNEDY, J. Orientation and spatial representation within multiple frames of reference. British Journal of Psychology. 1982; 73: 527-535.

SOLTIS, J. An introduction to the analysis of educational concepts. 2nd ed. Reading, Ma.: Addison-Wesley, 1978.

SOWA, J. Conceptual structures: information processing in mind and machine. Reading, Ma.: Addison-Wesley, 1984.

SOWA, J. Conceptual graphs summary. In: T. Nagle et al. (eds.) Conceptual structures: current research and practice. New York: Ellis Horwood, 1992: 3-51.

STREITZ, N. The role of problem orientations and goals in text comprehension and recall. In: A. Flammer & W. Kintsch (eds.) Discourse processing. Volume 8. Amsterdam: North-Holland, 1982.

SUNESSON S. & NILSSON, K. Explaining research utilization: beyond "functions". Knowledge: Creation, Diffusion, Utilization. 1988; 10(2): 140-155.

SWIFT, D., WINN, V. & BRAMER, D. A sociological approach to the design of information systems. Journal of the American Society for Information Science. 1979: 215-223.

TALJA, S. Constituting "information" and "user" as research objects: a theory of knowledge formations as an alternative to the information-man theory. Paper presented at the Information Seeking in Context Conference, Department of Information Studies, University of Tampere, Finland, 14-16th August, 1996.

TAYLOR, R. Information values in decision contexts. Information Management Review. 1985; 1(1): 47-55.

TAYLOR, R. Value-added processes in information systems. Norwood, N.J: Ablex, 1986.

TAYLOR, R. Information use environments. In: B. Dervin & M. Voigt (eds.) Progress in communication sciences. Volume X. Norwood, N.J.: Ablex, 1991: 217-255.

THAYER, W. & WOLF, W. The generalizability of selected knowledge diffusion/utilization know-how: the case of educational practice. Knowledge: Creation, Diffusion, Utilization. 1984 Jun; 5(4): 447-468.

TODD, R. Information load and choice behaviour: an experimental study of high school students when selecting books in a school library. LISR. 1992; 14(4): 447-464.

TODD, R. Integrated information skills instruction: does it make a difference? School Library Media Quarterly. 1995; 23(2): 133-139.

TOULMIN, S. The uses of argument. Cambridge: Cambridge University Press, 1958.

TOULMIN, S., RIEKE, R. & JANIK, A. An introduction to reasoning. New York: Macmillan, 1979.

TULVING, E. & DONALDSON, W. (eds.) Organisation and memory. New York: Academic Press, 1972.

TUOMINEN, K. & SAVOLAINEN, R. A social constructionist approach to the study of information use as discursive action. Paper presented at the Information Seeking in Context Conference, Department of Information Studies, University of Tampere, Finland, 14-16th August, 1996.

VAN DE VALL, M. & BOLAS, C. Using social policy research for reducing social problems: an empirical analysis of structure and functions. Journal of Applied Behavioural Science. 1982; 18(1): 49-67.

VICKERY, B. & VICKERY, A. Information science in theory and practice. London: Butterworths, 1987.

VICKERY, B. Knowledge representation: a brief review. Journal of Documentation. 1986; 42(3): 145-159.

VOSS, J., TYLER, S. & YENGO, L. Individual differences in the solving of social science problems. In: R. Dillon & R. Schmeck (eds.) Individual differences in cognition. New York: Academic Press, 1983: 205-232.

WAY, E. Knowledge representation and metaphor. Dordrecht, Netherlands: Kluwer Academic Publishers, 1991.

WEISS, C. Research for policy's sake: the enlightenment function of social research. Policy Analysis. 1977; 3: 531-545.

WEISS, C. The many meanings of research utilization. Public Administration Review. 1979; 39(5): 426-431.

WEISS, C. Knowledge creep and decision accretion. Knowledge: Creation, Diffusion, Utilization. 1980; 1: 381-404.

WEISS, C. Perspectives on knowledge use in national policy making. In: G. Beal, W. Dissanayake & S. Konoshima (eds) Knowledge generation, exchange and utilization. Boulder, Co.: Westview Press, 1986.

WEISS, C. If program decisions hinged only on information: a response to Patton. Evaluation Practice. 1988; 9(3): 15-28.

WEISS, C. with BUCUVALAS, M. Social science research and decision-making. New York: Columbia University Press, 1980a.

WEISS, C. & BUCUVALAS, M. Truth tests and utility tests: decision-makers' frames of reference for social science research. American Sociological Review. 1980b, 45: 302-313.

WERSIG, G. The changing role of knowledge in an information society. In: The Information environment: A world view. Studies in honour of Professor A. I. Mikhailov. North-Holland: Elsevier Science Publishers, 1990: 185-198.

WILSON, T. The cognitive approach to information-seeking behaviour and information use. Social Science Information Studies. 1984; 4: 197-204.

WILSON, T. & STREATFIELD, D. Information needs in local authority social service departments: an interim report on Project INISS. Journal of Documentation. 1977; 33(4): 277-293.

WILSON, T. & WALSH, C. Information behaviour: an inter-disciplinary perspective. A report to the British Library Research and Development Department on a review of the literature. Sheffield: Department of information Studies, University of Sheffield, 1995.

WINGENS, M. Toward a general utilization theory: a systems theory reformulation of the Two-Communities Metaphor. Knowledge: Creation, Diffusion, Utilization. 1990; 12(1): 27-42.

WOLEK, F. Managerial support and the use of information services. Journal of the American Society for Information Science. 1986; 37(3): 153-157.

WOLTERS, R. Union-management ideological frames of reference. Journal of Management. 1982; 8(2): 21-33.

YOVITS, M., DE KORVIN A., KLEYLE R. & MASCARENHAS, M. External documentation and its quantitative relationship to the internal information state of a decision maker: the information profile. Journal of the American Society for Information Science. 1987; 38(6): 405-419.

ZALTMAN, G. Knowledge utilization as planned social change. Knowledge: Creation, Diffusion, Utilization. 1979; 1(1): 82-105.

ZALTMAN, G., DUNCAN, R. & HOLBEK, J. Innovations in organisations. New York: Wiley, 1973.

ZHANG, Y. Definitions and sciences of information. Information Processing & Management. 1988; 24(4): 479-491.

ZHANG, Y. The development of knowledge use studies. Doctoral dissertation. Pittsburgh: Graduate School of Public and International Affairs, University of Pittsburgh, 1989.