Safety training and positive safety attitude formation in the Australian construction industry

Abstract

Poor safety is a perennial problem for the construction industry worldwide. While there has been a large amount of research on construction safety training and its importance in developing positive safety attitudes, much of the evidence has been anecdotal. To address this gap in knowledge, this paper presents the results of an attitudinal survey of 228 construction employees from a variety of professional and trade backgrounds operatives in Australia who went through mandatory site safety training. It was found that the training was largely ineffective in changing workers' safety attitudes. The minor change in safety attitudes that did occur were largely cognitive and behavioural in nature while the affective component of safety attitudes remained virtually unchanged. In other words, construction operatives emerged from the training with a slightly better knowledge of safety risks, a better intention to behave safely but not caring any more about safety as an issue. It was also found that gender, age and education are potential mediators in the safety attitude formation process. It is recommended that when developing safety training programs in the future, more attention should be paid to tailoring programs to the demographic characteristics of the people being trained and to the use of new interactive and immersive technologies and learner-centric andragogical pedagogies.

Keywords: attitudes, behaviour, construction industry, psychology, safety, training

Introduction

Despite many decades of policy reform, safety research and safety initiatives, the construction industry remains notoriously dangerous in many parts of the world. For example, in the Australian construction industry there were 37 work-related fatalities in 2015 (Safe Work Australia 2015) and in the UK construction industry there were 35 fatalities in the same year (HSE 2015). In developing countries, the statistics are much worse although highly unreliable. For example, according to Huang et al (2000) a conservative estimate of 3,000 construction workers are killed each year in China due to work related accidents.

The literature on construction safety is vast and long standing. The Association of Researchers in Construction Management database of theses, articles and conferences over the last thirty years lists 876 references with safety as a keyword covering a large range of technical, educational, psychological and behavioural issues (ARCOM 2016). Thirty-eight of these references focus on safety training as a critical factor in safety improvement and in early research Jannadi (1996), Tam and Fung (1998) and Langford et al (2000) found that safety training for both operatives and managers was one of the top initiatives that could be put in place to improve safety in the construction industry.

Subsequent work has added granularity to our understanding of why this is the case. For example, Wong et al (2000) found that the enhancement of safety knowledge after receiving compulsory safety training in the Hong Kong construction industry was significant and related to the educational background of the trainees. Wilkins

(2011) and Albert and Hallowel (2013) found that health and safety training programmes improve employee compliance with health and safety requirements in the construction industry and that trainees responded more positively when adult learning theories were integrated into these programmes. Oswald et al (2013), Zhou et al (2015) and Rodríguez-Garzón et al (2015) also found training to be a major factor in improving safety climate, safety perceptions and safety behaviour on construction projects.

In the pedagogical strands of the safety training literature, many authors have explored the use of new technologies like web-based tools, e-learning, video and virtual reality in enhancing safety training in construction (Carney et al 2008, Acar, et al 2008, Kamardeen 2011, Sacks et al 2013, Albert et al 2014, Edirisinghe et al 2015). Trajkovski and Loosemore (2006), Ulubeyli et al (2015) and Chan et al (2016) explored the challenges associated with providing effective safety training for the many minority groups that work in the construction industry looking at issues such as language proficiency and the value of visualisation techniques such as cartoons. The importance of using innovative learning techniques to facilitate high-engagement in safety training has also been emphasised by Namian et al (2016) who found that the knowledge acquired through many training programs is often not applied in the workplace.

Despite all this research into the importance of training as a safety improvement intervention, Nyateka et al (2012) found that the construction industry invests less in safety training than many other lower risk industries such as retail and catering. Indeed, a survey of 1052 employers and 1311 workers, Safe Work Australia (2015a) found that 39% of construction employers did not provide any work health and safety training to their employees which is lower than the proportion of employers providing safety training in other priority industries. While the exact reasons for this relatively low rate of training are unclear, research has pointed to factors such as time and cost pressures on construction sites which makes any training a burden and to the relatively high numbers of small firms and independent contractors in the industry which have limited resources to invest in training (Lingard and Rowlinson 2005, Loosemore and Dainty 2012).

Research has shown that training works on safety performance in a number of ways. For example, Lingard and Yesilyurt (2003) found that first aid training in construction made participants more aware that their own behaviour was an important factor in the avoidance of occupational injury and also appeared to reduce participants' willingness to accept prevailing levels of safety risk on site. This is important because a major survey by Safe Work Australia (2015a) found that 25% of all construction employees routinely accepted risk-taking as a normal part of their work. Research also shows that work-based training which provides people with direct experience of workplace processes and safety incidents can be a particularly powerful way to improve safety attitudes in construction (Shin et al 2014). For example, Hung et al (2011) observed significant differences in safety attitudes and risk perceptions could be achieved by interventions such as implementing informal training to supplement formal training. More recently, in Hong Kong’s construction industry, Tam and Fung (2012) concluded that mandatory training could improve people’s attention to their personal safety.

While there has been a large amount of research on construction safety training and the importance of positive safety attitudes, much of the evidence has been anecdotal

or based on managers' perceptions and the relationship between safety training and safety attitudes has not been empirically explored from a trainee's perspective. The aim of this paper is to help fill this important gap in knowledge by addressing the question of whether mandatory safety training courses for construction workers in Australia have any impact on their attitudes towards safety? More specifically, by mobilising theories of attitude formation, we seek to explore the affective, cognitive and behavioural impacts of safety training on construction workers, with the objective of identifying more effective ways of delivering such training in the future.

Safety training in Australia – a brief overview

Safety training in Australia is a legal requirement that is imbedded in the main Workplace Health and Safety (WH&S) Acts in each State and Territory in Australia, with training being outsourced to a range of accredited private education providers. Australia is not alone in its compulsory safety training requirement. In the UK, employers must also ensure that their supply chain (consultants, subcontractors and suppliers) have appropriate training that is proportionate to the risks presented by the relevant tasks to be undertaken by each particular worker (Health and Safety (Training) Regulations 1990). Hong Kong and Singapore also have a similar system of mandatory safety training (Wong et al 2000, 2009; Singaporean Ministry of Manpower 2016, Work Safety and Health Act 2006) and the US Occupational Safety and Health Act (1970) also identifies key employer responsibilities with regard to workers safety training requirements.

The Australian construction industry currently has four main levels of formal safety training (SWA, 2015): Accredited and Approved Courses; Vocational and Professional Courses; Licence or Certificate Courses; and Safety inductions. Typically, there are four types of safety inductions required in Australia:

- General Inductions: Prior to walking onto any construction site it is compulsory to obtain a General Construction Induction Training (GIT) card (also known as a White Card) by completing an accredited course. This training was the focus of our research and is aimed at the transfer of knowledge and skills described in a general construction training package that is delivered under the Australian Quality Training Framework (AQTF) by a Registered Training Organisation (RTO). People who need a GIT card include: site managers, supervisors, surveyors, labourers and tradespeople including people who access operational construction zones (unaccompanied or not directly supervised by an inducted person). GIT cards become void if a person has not carried out construction work for two consecutive years or more.

- Company Inductions: Once a worker has obtained a GIT Card, it is the responsibility of the employer to provide a standard company induction. This involves introducing each worker to company protocol and policies and expectations of behaviour.

- Site/project Inductions: Aimed at providing project-specific safety knowledge. The duration and content of training depends on the nature, complexity and level of risk associated with the project.

- Task Specific Inductions: Training needed to perform a certain task. The length and depth of training is also dependant on whether the task is classified low or high risk.

The formal safety training programs outlined above can be delivered in various ways using workshops, lectures, videos, demonstrations and increasingly new technologies such as virtual reality and gaming (Burke et al 2006, Newton and Lowe 2015). The mandatory GIT Card Induction Training which is the focus of this paper can also be undertaken via online correspondence in any state or territory in Australia other than New South Wales (NSW) where face-to-face training is a requirement. These online courses can take anywhere between one and four hours and consist of very general construction safety multiple-choice style questions. Students can bring a family member or friend to help them with the course and the only thing their friend of family member is not allowed to do is physically write on the participants assessment sheet.

Theory - safety attitudes in construction

In recognising the importance of safety attitudes in improving safety in the construction industry, Lingard and Rowlinson (2005) drew on the work of Steers (1981) who defined an attitude as, “A predisposition to respond in a favourable or unfavourable way to objects or persons in one’s environment” Steers (1981: 282). As Biggs, et al (2007) point out, attitudes play a strong role in determining behaviours and according to Langford et al (2000) and Lingard and Rowlinson (2005) a worker’s attitude towards safety will not only determine whether they behave safely in the workplace, but that they will also accept and adhere to formal workplace instructions and when necessary, take the initiative to implement informal practices which achieve the same goal. As Dekker (2014) recognises, this attitude-dependent willingness to move outside formal bureaucratic systems-based approaches to safety is critical and is supported by data from Safe Work Australia (2015a) which shows that there is little correlation between formal safety processes such as preparing Safe Work Method Statements and incidences of work related injuries. Indeed, construction firms spend relatively more time than any other high-priority industry creating Safe Work Method Statements, but at the same time report a significantly higher level of safety incidents than most.

The attitudes of construction workers towards safety have been explored from a number of perspectives. For example, Siu et al (2003) explored the relationship between age, attitudes and safety performance using a Chinese version of the Safety Attitudes Questionnaire (SAQ) developed by Donald and Canter (1993) and concluded that older workers were more inclined to demonstrate positive attitudes towards safety than younger workers. In support of this, Breslin et al (2007) found that young workers’ across a diverse range of jobs including construction, see safety risks and ’part of the job‘ due to a perceived lack of control to improve or alter the conditions of their work. While female complaints were actively disregarded by their superiors, men tended to cover up their concerns in order to appear mature among their (older) co-workers. A recent cross-sector study by Safe Work Australia (2015a) into attitudes to safety, informed by no specific theoretical approach, found that construction employers were much more likely to regard risks as unavoidable in the workplace (46%) than employers in the other industries (13%), that construction

workers were also more likely to agree that minor incidents were a normal part of their daily work (50% compared to 19% respectively) and that their workplace does not suit those overly concerned about being injured (44% compared to 13% respectively). Twenty six percent of construction workers agreed that they accept risk taking at work and 14% agreed that they would break safety rules to complete work on time construction.

While the above work on attitudes towards safety in construction is important, it lacks a strong theoretical base and the effect of training as a specific intervention to affect attitude change has received scant attention. To address this conceptual gap in our understanding of safety attitude formation in construction through training, the work of both Triandis (1980), Eagly and Chaiken (1993) is of value in that it shows that an attitude comprises three main components: *affective*; *cognitive*; and *behavioural*.

- Affective Component: The affective component reflects a person's values and how they may feel about a certain object or situation (emotional reaction). These feelings and emotions can often be shaped by past experiences that may resurface when similar situations are relived. For example - *'I am afraid to climb that ladder'.*

- Cognitive Component: The cognitive component of an attitude is informed by a person's knowledge and experience and reflects their beliefs about an object or situation. *For example - 'I believe I will fall if I climb that ladder because I have fallen off one before'.*

- Behavioural Component: The behavioural component of an attitude refers to the way in which an individual may act towards an object or situation. For example - *'I will not climb that ladder without a safe system of work and the correct equipment'.*

Social psychologists have long recognised that there is a relationship between attitudes and behaviour and have developed various theories to explain it. One of the most widely tested and respected theories is Ajzen's (1991) Theory of Planned Behaviour, which shows that a person's behaviour is influenced by: normative beliefs and subjective norms imposed by society and significant others (e.g. the behaviour of work colleagues or safety supervisors); control beliefs and perceived behavioural control associated with self-efficacy and the perceived difficulty of the action (e.g. It's difficult climbing that ladder and I can't control it if I fall); and by a behavioural intention which reflects an individual's readiness to perform a given behaviour. While Ajzen's (1991) Theory of Planned Behaviour has been used extensively outside construction in a range of safety contexts and industries such as aviation and public health (see for example Fogarty and Shaw 2010 and Javadi et al 2013), its use in construction has been very limited and restricted to environmental behaviour (Teo and Loosemore 2001), energy use (Yearley et al 2013) and workers' beliefs and attitudes towards OHS (Lingard and Yesilyurt 2003). Using Ajzen's (1991) Theory of Planned Behaviour, Lingard and Yesilyurt (2003) found that first aid training changed a sample of construction workers' attitudes towards safety and safety behaviour on site by making them more aware of the safety implications of their own behaviour in the risk of occupational injury, by reducing their willingness to accept safety risk and

by creating a stronger intention to avoid injuries. Importantly, in subsequent developments of his model, Ajzen (2005) also recognised that on some occasions, past experiences and perceptions can bypass behavioural intentions resulting in behaviour which is underpinned by no conscious decision to act in that way. This point is important since while we build on the work of Lingard and Yesilyurt (2003), it also qualifies Lingard and Rowlinson's (2005: 115) assertion that "individuals [with] negative OHS attitudes will behave unsafely only if they make a conscious decision to do so". Finally, in understanding attitude formation it is also important to note that a person's behaviour in-turn shapes the affective and cognitive components in a mutually reinforcing way (Glendon and Mckenna 1995). For example, if someone performs a construction task safely, then this will positively influence their knowledge of how to undertake a task safely and the positive safety outcome will make it more likely that the behaviour will be repeated. It follows that the opposite applies as well.

Method

Data collection

To explore the impact that training has on worker attitude towards safety an anonymous structured questionnaire was administered face-to-face to construction workers before and after attending compulsory GIT card Induction courses at accredited training centres around NSW Australia. Interviews were discounted because of the lack of time respondents have before and after safety inductions and the need for anonymity and a statistically representative sample. We recognise the limitations of focussing only on GIT Card inductions but this is the only compulsory induction training in the Australian construction industry and it is the only universally accredited and standardised training in terms of content and expectations. By focussing on this type of induction training we therefore eliminated many potential intervening independent variables in interpreting our results (such as differences in content and aims), although we acknowledge that despite being very similar to other safety induction courses in other parts of the world, research should be conducted into other forms of safety training to complement this study in the future.

The questionnaire was administered face-to-face during GIT Card training courses being run at accredited safety training centres in Sydney, Australia to maximise the response rate. There is no other reliable way to contact people who go through GIT card safety inductions. Although an electronic survey was considered, we could not guarantee that potential attendees had access to computers and the internet either before, during or after the training. There are also numerous other potential problems with on-line surveys other than access, not least ensuring that they are completed by the targeted respondents (Best 2008). Given the non-English speaking background of many construction workers, it was also important to be able to answer any queries face-to-face in answering our survey questions. Furthermore, to isolate any detected changes in safety attitudes over the training period, it was important to administer the survey immediately before and after the induction course. Face-to-face administration allowed us to minimise the time lapse and potential intervening variables between the end of the course and the collection of our attitudinal data.

Sampling

The accredited training centres where the questionnaires were administered using snowball sampling from among the accredited training centre population in Sydney, Australia. In simple terms, snowball sampling is a nonprobability sampling technique where a core group of respondents nominate other respondents to participate in the research. To maximise the sample size and response rate, the data collection focussed on the largest centres which train the greatest numbers of construction workers. During the sampling process, it became evident that many training centres did not want to participate in the research believing that it might damage their business and discredit their company. Nevertheless, through the snowball sampling strategy resulted, six out of fifteen of the largest GIT Card Induction Training centres approached agreed to administer the questionnaires to their trainees and of the 228 questionnaires administered, 218 were completed correctly (high response rates of 40% for the training centres and 96% for the respondents respectively). Table 1 shows the sample structure of those who completed the usable questionnaires.

Table 1 Sample demographics

INSERT TABLE 1 HERE

Survey instrument

Drawing on the conceptual work of Triandis (1980), Ajzen (1991) and Eagly and Chaiken (1993), the questionnaire consisted of questions covering respondent demographics based on extant empirical and theorised links to safety attitudes (age, gender, education, experience, previous safety training) and the affective, cognitive and behavioural components (normative beliefs and subjective norms, perceived behavioural control, behavioural intention) of their attitudes towards safety. The non-demographic questions which were used to test the affective, cognitive and behavioural components are listed in Table 2 and following Trochim's (2000) approach to scale formation, a five-point Likert Scale was used to elicit responses. . It is important to note that the questions used in the survey were designed to minimise acquiescence bias (the tendency for respondents to respond similarly to all questions) by asking the questions in a way which were not always positive. For example, in Q11, 17 and 18 a greater post-mean score indicates a negative change in attitude but vice versa in all other questions. It is also important to note that the questions were refined following a pilot study of six trainers which caused several adjustments to the questions to make them suitable for respondents from non-English speaking backgrounds (50% of eventual sample which is typical of the types of respondents found on construction sites in Australia). Furthermore, to ensure anonymity and minimise social desirability bias (a potential problem in all safety research), the questionnaires were administered and returned in a blank white envelope and collected after the course had finished and the respondents had left. Data collection occurred over a period of five weeks.

Analysis

The survey data was analysed using a paired sample t-test which allowed attitudinal change to be measured by the mean difference and a significant 2-tailed score.

Since our sample size is sufficiently large (>200), the Central Limit Theorem ensured that the sample distribution approximated normality which meant that a significant 2-tailed score of <0.05 represents a statistically significant change over time (Billingsley 1995). However, recognising that the sample size varies across the groups compared we also tested for this using Levene's Test of Equality of Variances which are produced in SPSS when running the independent T-Test procedure (this produces an F statistic and a significance P value which if more than 0.05 indicates unequal variances). Our results focus on reporting p value results <0.05 and where equal variances existed and where we were able to reject the null hypothesis that there was no differences in the variances between the groups we tested. When our p-value is less than 0.05 we can reliably conclude that there is a statistically significant difference between the mean scores in our sample groups.

Results

The results are presented below in relation to the relevant extant literature. First we explore the results across the entire sample and then present the results across different elements in the sample as depicted in Table 1. To this end, Table 2 illustrates the attitudinal change results generated from the paired sample t-test for the entire sample across all questions.

Table 2 Paired Sample T-Test results across whole sample

INSERT TABLE 2 HERE

The results in Table 2 are discussed below.

Building emotional engagement with safety training

Overall, based on the statistically significant changes in attitudes towards safety before and after the training, the results in Table 2 show that the induction course produced very little changein participants' attitudes towards safety. The statistically significant results show only a slight positive change of 3.78% in the mean score of the respondents surveyed before and after the safety training program as a proportion of the maximum possible change. This supports Kamardeen's (2011) research which found that current training schemes within the Australian construction industry are largely ineffective in this area. This result also supports Tam and Fung's (2012) survey of Hong Kong's mandatory safety training course, although the exact extent of the change in this study was unclear as was the theoretical framework used for attitude measurement which makes detailed comparison problematic. Adding further granularity to our understanding of how safety inductions affect attitudes, it is also notable in Table 2 that the affective component was virtually unaffected by the training, suggesting that the induction course no discernible impact on the emotional engagement of our respondents with safety risks. The results show that the main positive impact of the training was on the post-training knowledge-base and in particular on the behavioural intentions of its recipients (although the positive impact

was marginal within the context of the overall 3.78% overall change reported above). In other words, people emerge from this training with slightly better knowledge and safety behaviour but not caring more about safety. This could be because the level of emotional engagement with safety is high at the start of the training (which is partially born out of the results where the mean in this variable is higher on average than in the other variable). These results tend to lend some support to Lingard and Yesilyurt's (2003) research which found that first aid training changed a sample of construction workers' attitudes towards safety and safety behaviour on site by making them more aware of the safety implications of their own behaviour in the risk of occupational injury, by reducing their willingness to accept safety risk and by creating a stronger intention to avoid injuries. They also support Oswald et al's (2013) assertion that training is one of the factors that influences behavioural responses to safety although we do not find it is significant as Rodríguez-Garzón et al (2015) found in their research into the relationship between training and perceptions of safety risk. In terms of the affective impacts of safety training, it is notable that none of these authors mention any increased emotional engagement with safety as a result of the safety training they studied, although it is not clear whether this was tested or not in any of the cases. Nevertheless, our results suggest that there is a need to adapt safety training to create more emotional connection with the issue and to connect more strongly with trainee value-systems. New technologies such as virtual reality being experimented with in a construction safety context (Newton et al 2015) may be useful in this context since through real life immersion in the work environment and simulation of workplace accidents, they are able to create a stronger emotional connection with the subject matter. Our results also support calls by Lingard and Rowlinson (2005) who advocate a behavioural based approach to safety which applies the science of organisational behaviour management to construction practices through safety partnerships between managers and employees to create a sense of collective responsibility for safe work behaviour. The central elements of behaviour-based safety are: identification of unsafe work behaviours; development of model safe work behaviours; involvement of workers in observation processes; reward systems that acknowledge good behaviour; utilisation of participative and representative structures such as elected safety representatives, union delegates and safety committees. However, it must also be acknowledged that critics of behaviour-based safety programs argue that such programs should be just one, albeit very important, element of a broad safety system (Cooper 2009).

Changing safety training pedagogies

It is also interesting to note that after going through induction training, our respondents felt less inclined to think that safety training was necessary and less inclined to feel safer with someone who had gone through such training. It is certainly of some concern that our respondents thought the training was not necessary. However, the respondents did feel more competent because of the training possibly because the training awarded participants with a nationally recognised competency qualification which asserts that workers are able to identify safety legislation requirements, construction hazards / control measures, safety communication / reporting process, safety incident response procedures and that they are able to work safely in the construction industry. Our results indicate that the

outcomes of safety induction training strongly reflect these highly instrumental competency-based objectives. While Sacks et al (2013) explain that a construction worker's ability to identify and asses risk is acquired through training and experience and is among the key factors that determine safety in the workplace, it is also important to acknowledge Figgis and Standen's (2005) research into safety training in the oil and gas industry, which argues that that effective safety training is not just about competency development but about developing an emotional connection with the subject. This is clearly missing in our data and is supported by Silberman (2005) who proposes an 'active training' approach to safety training, using role plays, multimedia, field trips, games and action learning to encourage people to move outside their comfort zone and talk about their feelings, beliefs and attitudes. These findings are important since the emotional dimension of safety training is largely missing in the construction safety literature, which has tended to focus on the cognitive and behavioural aspects of the subject. While Sunindijo and Zou (2013) found that emotional intelligence is a key factor in the development of safety climate, their research was focussed on managers style rather than workers' emotional connection with the subject of safety. Similarly, while Tixier et al (2014) found that individuals in positive and neutral emotional states may be more prone to engage in risk-taking behaviours, their work focussed on emotional stability rather than emotional connection with the subject of safety. However, it is also important to recognise that beliefs and values are often the hardest part of an attitude to influence (Biggs et al 2007, Traindis 1980) and to this end our results support Hinze et al (2013) who argue for more high engagement safety training programs, suggesting that current GIT Card Induction Training in Australia could improve significantly if it moved away from the rather unimaginative and mono-pedagogical and one-way delivery style it employs. The ability to undertake the training online would seem to be particularly inappropriate in this context. However, moving to a more engaging mode of delivering GIT training would cost trainers more and lead to an increase in the price of safety induction training for employees, the majority of whom have to fund the training themselves. According to our results, this is likely to be a problem for participants who clearly put a price on safety since their responses indicate that would be more likely to attend the course if it was free.

The other positives in our overall results are that the participants left the course feeling that the training itself was effective and not intimidating. This is important because according to Demirkesen and Arditi (2015) the most effective safety training is simple and easy to understand. At the same time however, it must be effective training and our results show that the positive impact on safety attitudes at least, is far less than might be expected.

The gendered effects of safety training

Table 3 shows Paired Sample T-Test Summary against the independent gender variable.

Table 3 – Gender Paired Sample T-Test Summary

INSERT TABLE 3 HERE

Table 3 shows a gender-based paired sample t-test analysis of questions 7 – 19 with significant associations italicised and bold. Of the 13 questions, male respondents recorded 11 significant 2-tailed scores of <0.05. and for female respondents 8 significant scores were detected. Five of the question answers have a non-significant score from one gender group and cannot therefore be compared (Q 7,8,9,12,15). Previous literature on construction safety training and attitudes have not yet addressed whether the impact of safety attitudes has a gendered dimension. However, comparing the changes across other questions which returned significant scores it is evident that overall the safety attitude of women is more positively affected by training than it is in the male sample (although the absolute differences between men and women in our sample are small). While mean change in the significant affective component of safety attitudes is improved mostly in the male sample (0.275 male, 0.228 female), in both the cognitive and behavioural attitude components, women are affected more positively in every statistically significant question which can be legitimately compared. Although the changes are small overall, they do support wider research on gender and safety by Kauppinen et al (2003) and ILO (2013) which recognises that gender differences need to be considered in the development of occupational safety and health policies and prevention strategies such as training. In a construction context, although gendered training has not been explored, this is likely to be related to the different opportunities men and women are afforded in construction and the different physical and psychological risks they experience in the workplace (Dainty et al 2000,Fielden et al 2000, Lu and Sexton 2010, Galea et al 2014). As Kauppinen et al (2003) and ILO (2013) point out, gender differences in employment conditions have a major impact on work-related health outcomes and safety research and interventions must take account of the real jobs that men and women do and differences in exposure and working conditions. For example, the New York Committee for Occupational Safety and Health (2013) lists a wide range of gender-specific risks which face women working in the construction industry which include: belittling remarks, harassment and physical assaults; isolation; job Insecurity; ergonomics; personal protective equipment; reproductive hazards; sanitary facilities and poor health and safety training.

Age impacts of safety training

Table 4 shows the age-based paired sample t-test analysis of questions 7 – 19.

Table 4 – Age Paired Sample T-Test Summary

INSERT TABLE 4 HERE

The results in Table 4 illustrate that the youngest group (18-24) have the largest number of significant changes at 8, followed by age groups (25-31, 32-38, 39-45) with 5 and the oldest group (45 and over) with only 4 (half the youngest group). Overall, the affective component of attitudes changed least across all age groups with the behavioural component changing slightly more than the cognitive

component. The individual variables that changed the least were questions 7, 8 and 9 (safety training is necessary, risks of working with others) apart from in the oldest age group which was the only group not to think that the training made them more competent, which makes sense given their greater experience. In cognitive changes too, the oldest group underwent no significant change compared to the other groups, suggesting that they need a different type of training program to change attitudes. According to Aboagye-Nimo et al (2012), experienced workers tend to quickly and informally assess potential safety risks in different ways to younger workers and subsequently manage their work environment so as to prevent injuries or accidents from happening in collaboration with their co-workers. Albert and Hallowel's (2013) research into safety training also shows how older workers might learn in different ways. They argue that current safety training programs which primarily rely on instructor-centric pedagogical approaches are insensitive to the adult learning process and produce limited cognitive change in safety knowledge and need to better integrate learner-centric andragogical (self-directed) principles to improve engagement in safety issues. According to Albert and Hallowel (2013: 132) "adult learners feel a need to know precisely how learning will be beneficial prior to undertaking the learning process…. Adult learners are generally task or problem-centred in that they seek to learn practical lessons that they perceive can assist them with dealing with practical tasks and problems they will encounter".

In our results, the largest cognitive change occurred in the youngest group (not surprisingly given their age and relative lack of experience in the industry) and it is interesting than none of the age groups were more prepared to pay for safety training as a result of the training they received, even if it improved their safety outcomes. This is an important finding in adapting any future training interventions to a more consistent (Bahn and Barratt-Pugh 2013) interactive (Kamardeen 2011, Sacks et al 2013, Albert et al 2014, Edirisinghe et al 2015) and engaging (Namian et al 2016) mode of delivery. While new educational technology like virtual reality is to be welcomed as a mechanism for engaging people in safety training at a higher level, our results around paying for training indicate that this needs to be balanced against the potentially detrimental impacts of more costly safety training. At an absolute level, looking at the pre and post means of the oldest and youngest age groups, our findings support those of Siu et al (2003) and Breslin et al (2007) who both found that older construction workers were more inclined than younger workers to demonstrate positive attitudes towards safety in the construction industry. However, our findings are important since they indicate that the attitude of older workers are least affected by safety training than any other age groups.

Educational background and safety training outcomes

Table 5 shows an education-based paired sample t-test analysis of questions 7 – 19 with significant variables italicised.

Table 5 – Educational Background Paired Sample T-Test Summary

INSERT TABLE 5 HERE

The results in Table 5 show that those trainees with university qualifications are just as likely overall, to go through attitudinal change as a result of safety training as are High School and technical further education educated construction employees. However, the results do show that the nature of the change in attitudes is quite different with more highly educated students experiencing no significant change in affective response over the course of the training but the largest change in cognitive and behavioural response. This result is somewhat surprising given that these are the most educated group and perhaps reflects the nature of university education which often provides little insight into the practicalities of risk that graduates are likely to find on construction sites (Petersen et al 2008, Prasad et al 2015). The results for the technical further education and High School educated student groups are interesting and indicate that it is these students who emerge from safety training with the greatest change in emotional connection with the subject. These results likely reflect the very different emphasis on safety education in technical further education compared to university, with the technical further education sector focussing more on practical skills and knowledge and universities focussing more on safety theory than the other groups in this sample. University students are also likely to be younger and have less work experience than technical further education students which we know from the results in Table 4 is an important variable in training attitudinal change. There is very limited existing research which explores education level and safety training impacts however it is interesting here to draw parallels to Wong et al (2000) findings that the enhancement of knowledge after receiving the compulsory safety induction (Green Card Training) in Hong Kong's construction industry showed that enhancement of knowledge had a positive relationship with the academic background of the trainees but that knowledge enhancement, ultimately had no effect on reducing accident rates.

Conclusion

The aim of this paper was to use attitudinal theory to enhance understanding of whether and how safety training affects attitudes towards safety in the Australian construction Industry. The results of a face-to-face survey of construction employees from a variety of professional and trade backgrounds show that overall, the mandatory safety course we studied was largely ineffective in improving safety attitudes over the period of the safety training program, a result which supports other research into safety training in Australia and other countries like Hong Kong. Adding detail to this previous research, our results indicated that the affective component of trainee attitudes changed least with the main positive impact being cognitive and behavioural in nature. In other words, construction workers emerge from safety training with slightly better knowledge of safety risks and safety behaviour but not caring any more about safety. Overall, the practical implications of our results point to the need for safety training to be more responsive, flexible and interactive so that it creates a stronger emotional connection with the subject and elevates the importance of safety within trainee value-systems. Good safety training is not just competency development (which is often the emphasis in safety training) but about developing an emotional connection with the subject. In terms of responding to specific worker cohorts and demographics, our research also indicates that gender differences need to be considered in the development of safety training to reflect the different opportunities and roles women and men are afforded in construction and the different physical and psychological risks they experience in the workplace. Work-related risks to women's safety and health have been neglected in construction

research compared to men's, an imbalance which should be addressed in research and in the development and delivery of safety training in the construction industry. Our research also shows that current safety training is more effective for younger workers and that older workers need different strategies which better reflect the way they learn and apply their knowledge in the workplace. This will become increasingly important as the construction workforce ages and can be achieved in part through learner-centric andragogical pedagogies which facilitate more informal self-directed learning. Finally, our results indicate that the growing numbers of university-education students entering the construction workforce may require a re-think of training in order to increase their emotional connection with safety.

The limitations of our research relate to the relatively limited sample size and to the Australian context in which it took place (specifically New South Wales). We also acknowledge that our results are based on changes in respondents' safety attitudes before and after training and that we did not seek to statistiucally test any correlations between the variables. We also did not divide our respondents by cultural background nor test the competency of the trainers who delivered the training we studied. While potentially interesting, in reality these courses are delivered using a highly standardised approach with little discretion for applying any particular pedagogical approach. One of our recommendations is to develop a more engaging approach to the delivery of these courses to address the low affective impact of the courses we observed, and this could be an avenue for further research in the future, as would be the impact of these courses on different cultural groups.

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