

# Conversational voice assistants and a case study of long-term users: a human information behaviours perspective

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## ABSTRACT

This paper describes the human information behaviours of long-time users of voice assistants or chatbot software that focuses on voice interaction to retrieve information, and which operate on technologies that use artificial intelligence to understand and act upon the information requests of the user through a conversational interface. The paper reports on a case study based on 10 interviews with adult participants who have used voice assistants in their homes for at least six months. Interviews were semi-structured and focused on connecting to the users' and their family's experiences of using voice assistants in their daily lives. Insights from our findings focus on two areas, how the humanness of voice assistants and their perceived personality affect information retrieval, and secondly, the difficulties in transitioning from text-based information seeking to speech-based interactions. This paper makes a case for expanding human information behaviour studies to include interactive conversational information retrieval devices such as voice assistants.

## KEYWORDS

Chatbots, Voice assistants, Smart speakers, Conversational Information Seeking, Human Information Behaviour

## Introduction

Technologies based on Artificial Intelligence (AI) have penetrated many organisational processes, augmenting human intelligence, and assisting with organisational decision making (Jarrahi, 2018). These include chatbots and voice assistants, which are AI-based technologies that simulate human interaction through an embodied conversational agent. With a focus on human conversations, these conversational agents enable users to access information more easily among other tasks. There has been considerable research in using chatbots in business and organisational contexts for over a decade now (Luo et al., 2022). While these AI solutions are built within a particular business context, tech-giants like Apple, Google, and Amazon have developed commercially available voice assistants. In the past few years, household information devices using voice modality have become increasingly available and affordable, and many people have welcomed them into their homes. In the literature, they are variously termed as automated question answering (Q&A) systems, smart speakers, Intelligent Personal Assistants (IPA), digital personal assistants, voice-controlled, or conversational agents (Lopatovska et. al., 2019). Researchers have found that when the interface is in spoken format, the participants seemed to change the way they interacted with the information retrieval (IR) system (Xiaojun & Sa, 2017). When using a textual interface, the IR system was simply a computer to the users. But when using a spoken interface, the IR system became a live object, or an agent they were

communicating with (Xiaojun & Sa, 2017); some participants also reported it as more ‘fun to use’ (Begany, Sa, & Yuan, 2015). Crestani and Du (2006) found that users behave and perceive differently in systems with different input modes. They also found variations between written and spoken queries, and written queries were more effective than spoken queries. These devices have become much more commonplace and are found in many homes. Although there are volumes of research on these conversational agents from a systems perspective (Azzopardi et al., 2018; Radlinski & Craswell, 2017), there is not much research on how these devices are integrated into the life worlds and the information worlds of its home users, and how they aid or hinder knowledge acquisition.

Libraries and other databases are at their core, a source for information and knowledge.

According to Janes:

“...cultural heritage, and the human record that tells those stories, is entrusted to us to preserve, collect, organize, manage, search, and help people to use, and that’s what we do... We make humanity more human. We grease the wheels of knowledge, so that the people we serve can consult that human record more easily and effectively, and use what they find to learn and better themselves and their communities” (in Rubin, 2010, p.viii).

Just as we have taken time to curate these repositories of human knowledge, users also spend time learning how to navigate and use these sources. Just like learning how to use a library or a search engine, users now are also experiencing a learning curve in relation to chatbots and voice assistants, where the expectations of how to use the devices fall short of how users are integrating them into their daily routines (Luger & Sellen, 2016). Regardless of these issues, through chatbots and voicebots knowledge is more accessible than ever; no longer do users need to travel to a physical space like a library, or even move their body to access a computer, tablet or phone. Now users can simply speak aloud to the voice assistant in their homes. Whilst voice assistants may embody multiple different types of devices, from televisions, to toothbrushes, the form of the modern aesthetically minimal smart speaker is synonymous with the voice assistant experience. Sleek plastic and fabric devices sit on bookshelves, kitchen counters, or desks, ready and waiting for users to ask, “Alexa! What’s the weather today?”, “Siri! What is 67 percent of 800?”, or, “Google! Give me a recipe for Pumpkin Soup!”

Digital libraries, search engines, and voice assistants, with their different affordances, may trigger forms of anxiety in users, similar to library anxiety, described in detail by Shelmerdine (2018). Users can also experience digital anxiety or the fear of using computers and new technology and of making mistakes (Kim et al., 2021; Hackbarth et al., 2003; Sievert et al., 1998). As a result, many people avoid using the knowledge resource as they may not understand how it works, for they are unable to discern the affordances, or the ‘perceived possibilities that arise in the encounter between a person, an object, and an environment’ (Lundh & Johnson, 2014, p.4). Brophy and Brawden (2005), compared the experiences of information retrieval through libraries and through search engines. They found that both had pros and cons in terms of coverage and accessibility, or quality of results. From their case study analysis they deduced that a combination of both systems was needed to yield the best answers, as they both have access to different resources, and that, improving the information-seeking skills of the searcher is likely to

give better results. However, there has been no empirical study of users who use voice assistants for information retrieval, not to mention their information behaviours when doing so.

Libraries, search engines and chatbots are resources essential to finding and accessing information, and consequently, our information behaviours affect and are affected by our ability to use these resources. Brandtzaeg and Følstad (2018) wrote about the need to research the needs and motivations of real-life chatbot users. They also noted that people use media technologies strategically by employing different media technologies for diverse purposes, for ‘media users select [from] among media technologies based on how well a certain media form helps them meet specific needs or goals’ (Brandtzaeg and Følstad, 2018, p.41). This paper reports on a study of real-life chatbots users, whilst employing human information behaviours as a lens to examine how users experience voice assistants as an information retrieval system.

Our main research question is: How and why are users utilising voice assistants to fulfil their information needs? And how would they describe this experience?

To answer this, we report on findings from a case study, using interviews with 10 long-term (6 months+) adult users of voice assistants, to understand how their human information interactions were reshaped through a voice user interface. We report on data gathered from users who had at least one voice assistant in use in their homes for more than six months.

The specific questions that we investigated are:

- 1) How do users interact with voice assistants and with other users within their physical interaction spaces?
- 2) How do users’ perception and understanding of embodied devices that speak in a human voice change the way they seek, use and interact with information?
- 3) How do users learn to use voicebots from other people? This includes the people who design voicebots, those who teach them how to use voice assistants, and through observing others.
- 4) How do users’ relationships with voice assistants affect their relationships with others?

From our findings, we extend our insights into the field of human information behaviours to include information seeking through voice information retrieval devices. We divide our thematic analysis under the headings, *Information search and voice assistant ‘personality’*, *Serendipitous information encounters*, and, *Adjusting to new ways of searching and browsing*. This paper points to pathways for librarians and information practitioners to extend their professional knowledge to a field of work we may have thought was out of reach - harnessing the power of social AI (chatbots and voice assistants) in helping with users’ information needs and information access. Our paper also champions the importance of understanding the information behaviours of voice assistant users for those currently developing these digital products.

## Literature Review

### *AI-Powered Voice Assistants*

Emerging from the field of social robotics is the study of social artificial intelligence, an area that investigates and models the social and cognitive behaviours elicited by conversational agents like chatbots and voice assistants (Damiano & Dumouchel, 2018). Conversational agents have evolved into a complex digital tool and are inspiring a quickly expanding field of research. A tool that communicates information, shapes knowledge, and engages in human-like conversations, voice assistants are being studied, designed, and used in various contexts.

In their thesis, Ugale (2020) outlines the many domains applying conversational agents to the digital transformation of their workflows. From financial services, where conversational agents are saving businesses money (Bassett, 2018; Chong, 2017), to customers being more trusting of the objective advice of an AI program (Lui & Lamb, 2018), to e-commerce, where conversational commerce has given shopping a platform in social messaging apps (Van Eeuwen, 2017). Recruitment services are also deferring to conversational agents to liaise between potential hires (Sumser, 2016). Legal services are deploying conversational agents to give legal advice to clients (Dale, 2018), and in the healthcare domain, many uses for conversational agents are being investigated as ways to improve quality of life including providing accessibility and safety for seniors (Kocaballi et al., 2019).

Many of these studies converge on the lack of a human presence, and whether this is a positive additive, such as marginalised communities appreciating the lack of judgement from human-like devices (Jang et al., 2021), or a negative additive, such as supplementing skilled human workers and losing the tacit knowledge that comes from human lived experience (Hilton et al., 2013), is still being debated in the literature. Researchers have also raised concerns about gender stereotyping (Chen, 2013; Woods, 2018), domestic hierarchies (Halevy et. al, 2011), privacy implications (Marino, 2006) and labour concerns (Jandric, 2019).

McKie and Narayan (2019, p.6) describe conversational agents as ‘a library of answers that are organised to respond to the goals of its user’. In regard to this library of answers, one aspect of conversational agents has not been addressed in the literature: the epistemological implications of these AI-enabled systems. Vang (2013) explores the ethical implications of organisations such as Google acting as gatekeepers to information with their services such as their *Knowledge Graph* which deems to provide a direct, single answer to a query rather than just present a set of search results. As Vang recognised, the term *googling* is now commonly used by many to satisfy their need for justifying a pre-existing belief (2013, p.252). To many, the technical proficiency needed to develop and understand how these machines work is out of reach. Even when users of varying levels of digital literacy have adopted conversational agents, the literature shows that key issues such as accessibility, ethics, intellectual property, privacy, and security still remain unresolved, with some examples of malicious agents already exploiting users’ trust (Cahn, 2017). Thus, a lack of transparency can lead to many assumptions regarding malicious activity such as privacy threats (Chung, et al., 2017), ethical misconduct (Alaieri & Vellino, 2016) or out of control self-learning chatbots such as Microsoft’s Tay which learned to be racist and anti-Semitic (Neff & Nagy, 2016).

Despite the concerns above, AI-assisted conversational agents have been deployed across diverse application areas. Conversational agents in voice format are referred to as voice assistants and have recently reached commercial saturation (Laricchia, 2022). Voice assistants such as Amazon's Alexa, Google Home, and Apple's Siri are embodied via many devices (smart speakers, televisions, cars, phones, watches, and more) that users interact with in their everyday lives to connect to information or control other smart devices. Due to their dependency on human language as their main source of interaction (compared to computer languages and tactile-based input devices), voice assistants rely on being anthropomorphised and are designed to speak and be perceived as human-like. As Tondu writes, to be effective, non-humanoid technology needs to resemble humans to be able to operate in human spaces and contexts (2012).

Aside from such key advancements in technological infrastructure, Dale (2016) attributes the re-emergence of the conversational agent craze to the cultural development of how people communicate. The popularity of instant messaging and multitasking today means we are accustomed to 'short, typed interactions' (p.815) and often engage in 'several asynchronous conversations' (p.815) at once. As voice assistants become increasingly pervasive and ubiquitous, users may find themselves having to speak more and more to artificially intelligent beings in their home, work and school lives.

### *Human Information Behaviour and voice*

Information Behaviour research, also known as Human Information Behaviour (HIB) research, to distinguish it from cognitive psychology research around other animals, is a field of research within Library and Information Science that investigates how humans need, seek, and use information in everyday life, including professional, community, domestic, and personal contexts.

Related areas of research such as information retrieval (IR) and human-computer interaction (HCI) cover the system side of the information-searcher information-system interaction, while human information interaction (HII) studies the searcher-system interaction during the actual search event (Fidel, 2012). However, they have limited explanatory power of the concepts that underpin information seeking/problem solving levels (Spink & Cole, 2006). Therefore, HIB studies human behaviour before and after the search event. It investigates the broad, often chaotic sociological and psychological context that determines information-seeking behaviour, focusing on barriers to successful information seeking, be they cognitive, affective, psychosocial, or community based (such as accessibility), and why people often avoid information altogether (Narayan, Case, & Edwards, 2011).

Such informed understanding of how people interact with information in a given context often has high-stakes practical applications for making that information more accessible (Case, 2012). As such, research into information-seeking behaviour has been conducted within a wide variety of contexts such as News Media, Digital Social Media, Health Information Seeking, Education, Market Research, and Public Communication (Case, 2012). However, there is limited empirical research in HIB when it comes to newer information technologies such as voice user interfaces as information systems. Lopatovska et. al (2019) conducted a study of 19 participants using a combination of surveys and diaries and found that voice assistants were primarily used for

checking weather forecasts, playing music, and controlling other devices, and suggested that the interaction experience is more important to the users than the interaction output. They suggested that more work is required to understand whether users treat voice-controlled applications as primarily a traditional information retrieval system, a casual leisure system, a control interface for smart home devices, or, simply, as a new toy (Lopatovska et. al., 2019).

Xiaojun and Sa (2017) found that participants used significantly more stop words in the spoken language input interface than in the textual input interface for both interpretive and exploratory tasks. Participants used significantly more indicative words (such as ‘what’, ‘when’, ‘where’, ‘which’, ‘why’, ‘who’, ‘whose’, and ‘how’) in spoken language input interface, than in the textual input interface for factual tasks; in the textual interface, they tended to use more targeted task-related keywords (Xiaojun & Sa, 2017). Research on information behaviours related to voice have been explored in studies based on the use of audio-based reading technologies, and more specifically on users with impairments that rely more on voice technologies (Berget & MacFarlane, 2020). Users with sensory impairments like visual or hearing impairments have experience with information seeking through screen readers; some insights from research in this area found that the lack of persistence in screen readers puts a heavy load on short-term memory (Sahib, Tombros & Stockman, 2014), and that users with reduced vision formulated more expressive queries in an attempt to reduce iterations with search results pages... and had to rely more on content than structure and layout (Sahib, Tombros & Stockman, 2012). Insights from this area can definitely be transferred to use of voice assistants and shed light on information behaviours related to voice interaction. That said, this literature review does not cover studies on audiobook user experience which is often a passive listening task and does not include conversational interaction.

## **Research design**

In our study, we set out to deepen our understanding of human interactions with AI-powered voice assistants by investigating the lived experiences of long-term users (6 months+) of voice assistants. This case study discusses the results from ethnographic interviews with ten participants *in situ* in their homes alongside their voice assistants (including live data).

### *Study participants*

To learn how users have adapted to using voice assistant interfaces, we interviewed 10 users that had been using a voice assistant for more than 6 months. Our participants range from a diversity of ages, digital literacy, and household composition. It is also important to note that these participants were the primary owners of the voice assistant devices, and that the primary owners were more likely to self-nominate to be interviewed. Further down, we plan to also interview other members of their household that co-exist, usually consensually, but also involuntarily, with a voice assistant in their home. The findings of this paper are based on owners of the voice assistants that are actively trying to get the most out of the purchase they have integrated into their, and their family’s private lives.

Our research design was approved by the University of Technology Sydney’s ethics clearance process. This included a review of our interview protocols and research instruments of semi-structured interviews and ethnographic observations. All participant names and other identifying

information have been anonymised and de-identified in this paper. However, it was important to the researchers to keep names within their cultural domain to not colonise their identities. Participant household members are listed here to contextualise their home environment and family dynamics. We identified our participant's age, nominated gender, occupation, household composition and the number of devices (see *Table 1: Participant details* in Findings section). We chose not to record our participants' voice preference for their voice assistants; however, if it was different from the default voice, the change was discussed in the interview and shared in this paper if significant.

### *Interview protocol*

Interviews with participants lasted 45-90 minutes and used a detailed semi-structured interview protocol that also asked participants to recall interactions with their voice assistant based on memorable instances; for example, has any of the voice assistants...

- ever crept you out?
- made you laugh?
- annoyed you?

As human-like as voice assistants are, it may have been easier to recall such unexpected responses, interactions, or holistic experiences (like you might describe an exchange with another person). Since participants were chosen for their long-term use of voice assistants, it is likely that participants would be able to recall high impact interactions that sparked meaning or affect. Additionally, questions about use were raised such as length of use, reason for use, and general use and observation of usage by family members.

As well, users were encouraged to demonstrate live to the researchers any interactions, whether it be a command or a question, if they felt comfortable doing so. This helped us to observe their complete embodied interaction, from facial expressions, eye contact, and gestures between the participant and the voice assistant. These emotional responses also allowed us to observe any barriers or mishaps that interrupted the user's search for information, such as misunderstood commands, glitches, or complete confusion from either from the participant or the voice assistant AI. These are all important cues in understanding information behaviours, as emotion is an essential component of understanding human information behaviour and sense-making (Fourie & Julien, 2014; Savolainen, 2014). Another factor as well is to consider how the replication of emotions by voice assistants can in turn affect the information behaviours and sense-making of our participants. This interplay between human-computer interaction, human-information interaction, and human-information behaviour are explored below in our findings.

### *Analysis based on theoretical framework*

The interview data was analysed using reflexive deductive thematic content analysis (Braun & Clarke, 2019.) individually, then analysed again as an aggregate. The wider study from which this paper is derived uses ethnography, social constructivism, sociomateriality and embodied interaction to inform the study's design. The overarching research of which we report just one case study here, asks how users construct an understanding of voicebots and how this understanding shapes their perception and use of voicebots; we employed four case studies to investigate this: ethnographic interviews with long-term users of 6 months+ (reported here),

focus groups with children, case study of senior citizen users, and an auto-ethnographic study based on the experiences of the researchers.

The ethnographic approach helped us focus on user experience through the ‘everyday saying, doings, and relations with objects that make up what people do in their everyday lives’ and help to ‘make practices visible’ by placing ‘everyday objects and practices that we may otherwise not notice’ as the cynosure (Macleod et al., 2019, p.180). Social constructivism is used in this study to allow for the investigation of the understanding, perception and use as set out in the wider study’s research question, for ‘the mind constructs reality in its relationship to the world, this mental process is significantly informed by influences received from societal conventions, history and interaction with significant others’ (Gergen, 1999, p. 60). Sociomateriality has been defined as the ‘intuitive entanglement of human and technology in organised life’ (Monteiro, Almklov & Hepsø, 2012), which helps to frame how our participants frame their lives around, or adapt their practices to include their voice assistants. And lastly, embodied interaction refers to not only the physically embodied interactions of our users, but also the contextual embodiment that affect their interactions, ‘against a backdrop of an equally embodied set of relationships, actions, assessments and understandings’ (Dourish, 1999, p.8).

## **Findings and Discussion**

Our findings are organised as follows: how we search for information, and how we process the information presented to us by AI voice assistants like Google Home and Amazon’s Alexa. Within these broad categories, we present sections based on our thematic analysis, which binds conversations with our participants across a common theme. Quotes from our participants and reflections from the researchers are interwoven between recounts of the interviews and any connections to the literature. The participant details are tabled below (Table 1).

Table 1 goes here.

We have edited the participant quotes for clarity and ease of reading, as conversationally, human conversation is much messier than a scripted voice assistant. Whereas we as humans may struggle to translate thoughts to words, voice assistants will read from a script, and struggle with translating our words into their ‘thoughts’ consisting of natural language processing and AI modelling. For instance, when answering an unexpected question on the spot, it is difficult for us to pre-empt the sentence we are uttering before we finish saying it. Word by word our sentences form. Often if the context is quite serious, we may find it easier to close our eyes and really focus on what we want to say. Unlike a database of information, whether it be for voice assistants, search engines or libraries, there is little opportunity for us to clean the data, refine or edit it before we publish our thoughts out into the world during a conversation.

### *Information search and voice assistant ‘personality’*

Chatbots and voice assistants rely on establishing a personality to provide consistency and familiarity to an otherwise inanimate database of information (Mckie & Narayan, 2019). Many studies have mapped the personality traits of voice assistants to existing personality scales (e.g. Nasirian et al., 2017) or have tested the effect of different personality traits by designing or modifying existing voice assistants (for example, Braun & Matthes, 2019; Danielescu, 2020).

Researchers have also confirmed that the varying brands of voice assistants are perceived to have varying personalities and extend on the established brand personality of major technology powerhouses, i.e. Google, Amazon, and Apple (Poushneh, 2021). For example, Narayan & McKie (2018) described a child who addressed these voice assistants with great affection, as Uncle Google and Auntie Alexa.

Perceived personality and the act of assigning personality to inanimate objects through personification plays an important part in searching for information through voice assistants. It's essential here to clarify the difference between personification and anthropomorphism in voice assistants. Personification means to attribute human-like qualities to a non-human object (grammar.yourdictionary.com, n.d.), whereas anthropomorphism refers to the conscious design of non-human objects to be human-like (Tondur, 2012). One is an effect on perception, the other is a result of perceiving.

Phoebe is a children's librarian, who, with her partner, has welcomed three Google Mini devices into their home. Google Minis are smaller-sized speakers that can be tucked away on a bookshelf or table. They sport a fabric casing and a few buttons with options to control the volume, mute, and power. We asked Phoebe if she uses a nickname for her voice assistant Google; she denied it, but during the interview repeatedly called her devices her Minis in an affectionate tone, as well as attributing she/her pronouns to her female-voiced Google voice assistant. In our interview, Phoebe describes the Minis as having a split personality,

She'll give me the complete personality for a Google response of, "oh, like this is a book about blah blah blah. Would you like to hear a synopsis?" Her explanations will always end up just being sort of the sterile Google answer response.  
- Phoebe

When she engages with the device, she said she consciously speaks in different ways to suit her information needs. When she's bored, or in a fun mood, she will ask the Minis for a joke or personal questions about themselves in a relaxed manner. She refers to these as subjective questions and doesn't expect Google to answer with factual and authoritative information.

The only time that the Minis would give a different answer than if you just looked up and Googled something [on a web browser] is when you ask something that's personality-based, like, do you like me, or things that are more subjective, it varies.  
- Phoebe

As humans we mostly have the ability to construct and communicate our own identities in social settings (Rutherford, 2007), and similarly, Phoebe gives the Minis the space to express their identity as well.

The answer that you'll get and then those things are also less likely to be an answer that you don't like, because it's like, well, it's up to her how she

answers.  
- Phoebe

In turn, Phoebe's perception of split personalities for her voice assistants has affected her strategies for using the interface to find information. She expects to find subjective information when she asks personal questions to her Minis or expects objective summaries of information for factual-type questions. She makes sure to ask questions "the right way" to skip personality and get straight into accessing objective information,

...but then when you're asking for information, that's more something that... you're gonna get the straight answer. If you ask the question the right way...  
- Phoebe

Phoebe defines "the right way" by comparing it to "the bad way", and more so comparing her voice information seeking to her conventional ways of searching on the internet through typing a sentence or phrase.

... even when you're just googling something, if you ask... If you word the question badly, you're less likely to get the right answer, but if you ask the right question, then the answer is just gonna be what you would get if you type it into Google, so you'll generally get a good answer from it.  
- Phoebe

The experience of using voice assistants was succinctly explained by one of our participants who said that,

...it comes down to two things, not understanding me, and giving me the wrong bits of the information.  
- Hao.

For a few of our users like Phoebe and Hao, the inference of personality through the scripted dialogue of their voice assistants negatively impacted their ability to rely on the AI as a way to search for information. Hao works in academia and introduced a range of Amazon Alexa devices to his wife and their primary school-aged daughter and son. Hao enjoys using voice assistants as an additional teaching aid to engage students with the information he presents in his classes,

I use Siri during my classes just to look up things or show the kids [some] stuff, it just adds that extra layer of information if I need it...  
- Hao

The audio presentation and ability to frictionlessly look up information adds variety to how his students consume information. However, as opposed to this professional setting, in his personal use at home, during his own private information searching, he often feels a disjunct between access to information, and the voice assistant's personality acts as a barrier to accessing information. As he described,

It gets to that stage where it's lame and then it gets annoying, just give me what I need, and then I'll move on. You don't need to have the extra bits, they're... I think the extra bits try to make it sound human, but it's not human, deep down inside it's not human.

- Hao

The choice of words, 'deep down inside' as a metaphor, expresses that to Hao the humanness of the voice assistant acts as an external layer masking the voice assistant's true computer identity. As Hao has expressed, the value of accuracy of information trumps the voice assistant's attempts at human personality. Although Hao thinks there are interactions where voice assistants objectively relay information, e.g., simply reading Wikipedia or IMDB entries (discussed below), the assumption that voice assistants are required to assume a consistent personality is arguably not needed in one's quest for finding information. However, it's very hard to avoid perceiving a human presence when using voice assistants in one's information seeking, for as humans, we are not used to non-human entities interacting with us through voiced language.

Human presence is of course what makes libraries so valuable as places of information interaction. On the contrary, search engines have all personality stripped, as we begin our information searching on a blank tab and a salient text box. However, just as an old-fashioned notion of a stern librarian caused library anxiety for some users (Shelmerdine, 2018), and the depersonalised search engine is less scary for others (Silipigni & Randall, 2013), interactions with voice assistants are comfortable for some, and awkward for others.

Even minimal cues can emit some sense of personality or character for humans to relate to voice assistants (Araujo, 2018; Xu & Lombard, 2017). However, even when personality isn't coded into voice assistant dialogue, our participants have ascribed characteristics based on the device's ability to retrieve information - helping our users stumble closer to their information goals,

If she was a person... Wow. I would say helpful. They're knowledgeable, friendly. I don't find her words intrusive or that she's rude... Basically, when you talk to... Yeah, when you give a command, she would... Even if she doesn't know how to do it, she will answer it nicely.

- Lien

Lastly, this experience of personality is varied across devices, when we switch between the branded "tone of voice" of Google, Siri, Apple or Amazon, not to mention the independent developers of voice skills. Written for different purposes and audiences, skills can be installed into a voice assistant's repertoire through an app store. These skills can range from games, to Internet of Things (IOT) or smart home controls, to useful tools and tips. These are often vocally branded and will use a combination of the voice assistant's standardised voice, sound clips or recordings of other voices. During the interview with Mark, we shared a moment of fear as the voice of the game show host from the Movie Quiz Skill startled us.

Movie Quiz Skill: Welcome to Movie Quiz. How many people want to play Movie Quiz?  
You can say one to four...

Mark: One...

Movie Quiz Skill: What is your first name?

Mark: Mark

Movie Quiz Skill: Great, Mark, where are you from?

Mark: Oh, okay. That's a bit personal...I just thought that he was asking for personal information and I was like, why is it - the tone was so serious.

- Mark and the Movie Quiz skill

Not only do the voices and type of conversations change, but the rules of interaction do too. Users are finding themselves having to relearn new rules of interaction when they choose to integrate independent third-party skills; some voice skills or apps are commands that are selectively available for use if created by third-parties or installed by default by voice assistant providers. Similar to an app you may find on an iPad or could download from the App Store. One illustration is Vincent and his partner's experience with using the Pikachu voice skill. Not only did the Pikachu skill manifest a new personality, but we also had to change the commands we would use with Google Home in order to use it successfully.

You call for Pikachu, Google Home just responds to you through the pikachu voice, but... It was pretty annoying anyway, we didn't know how to turn it off...we had to look up how to turn it off...I think you just ignore - you just don't interact with the Google Home and then it - Pikachu goes away. Yeah.

- Vincent

Although an exciting experience, it may be difficult for Vincent to trust skills to work seamlessly after the Pikachu mishap. In the next section, we will explore how, in voice assistant interactions, we've learned to expect the unexpected, especially when using the devices as a point of information retrieval.

### *Serendipitous information encounters*

In information behaviour studies, often the focus is oriented to goal-directed information searching, whilst 'serendipitous or accidental discovery of information has often been neglected in information behaviour models' (Agarwal, 2015). There are different terminologies in the literature to describe this phenomenon, and Erdelez and Makri (2020) have proposed that the various terms such as information encountering, accidental information discovery, incidental information acquisition etc., be brought into the one umbrella of *information encountering*. Interestingly, in our findings, voice assistants are shown to lead their human participants down a path of switching between serendipitous and specific information searching. Our participant Jenni works in IT and lives alone and attributes this switching to the AI's imperfect intelligence,

You're expecting the device to give you an accurate answer because it is meant to be intelligent, so you're expecting it to give you the right answer; but it's not a perfect intelligence. It's not often that you do get it, but it does actually lead you down... interesting paths sometimes.

- Jenni

This perceived difference between an accurate answer and a right answer indicates that Jenni has lowered her expectations of the quality of information presented through voice information retrieval. Whilst it's unclear what Jenni's description of what an accurate or right answer may be, she is aware that using voice assistants may compromise the quality of the information sought. Learning to balance the chatbot's technical ability with their information needs is a common aspect of users' information behaviour in voice assistant interaction.

The next compromise in voice assistant information seeking is losing control over our ability to search and browse results, and instead we experience serendipitous retrieval, not unlike selecting the "I'm Feeling Lucky" option on the Google search page. Whether the inconsistent answer from a voice assistant is a result of using a slightly different combination of words in questions, or because the voice assistant hears you incorrectly, inconsistency remains in the information retrieval process when using them. However, Jenni's response towards these "interesting paths" of uncertainty was positive, and she says,

So it's not such a bad thing that it will give you an answer, which is not quite what you're after, and then you might ask it again or... Oh, okay, what does that mean? And then it goes somewhere else. So yeah, okay.

- Jenni

Agarwal (2015) described serendipitous searching as leading to accidental discoveries, and users' information retrieval interactions with voice assistants feel mostly accidental; however, they do not always lead the user to discover new information. Many sources of information are silenced as we are only presented with a single search result from a predetermined information provider; for example, Amazon uses results from the Bing search engine (Snead, 2020), while the Google Home uses Google.

There is a difference when you have sort of a curated response because if you wanna browse for information about something, and you ask your Google Home Mini, it's gonna choose what answer you get; you're gonna get one, it can present you with the answer... And when that's not what you want, you're going to have to ask another question. It has to be that call and response feature, whereas with Google [search engine], it'll be like here's all the possible answers, have a go, which in a way can be a positive and also a negative, depending on what kind of experience you wanna have...

- Phoebe

This could also be because we are served a selected piece of information by voice assistants that is taken directly from the internet. Whilst written for the specific affordances of Internet

browsers (endless scrolling pages read from left to right at your own personal pace) voice assistants can only process one block of spoken information at a time in one response. Phoebe describes this experience,

...she'll literally just read the text from the website as it's written, and that can turn out to be not very conversational and therefore hard to kinda listen to, so if it was able to take the information from a web page and format it into a conversational way of presenting that detail; if she was able to go like, 'These are the titles of the films, I will now put those into a script that I'll then read out in a way that is a bit easier to hear', that would probably be a better way for it to be programmed, but not the way she does... You could ask, I guess, a more tailored question would be, "Hey, Google, what's the top-rated film that Anya Taylor Joy has been in?"  
- Phoebe

During our interviews, we asked participants to demonstrate interactions – some of these included looking up a fact online. Once Alexa or Google started reading though, it seemed to go on forever, reading from a Wikipedia page, rather than provide an answer, and often it was too much information that was difficult to digest through auditory stimulation alone, much like that one person in a conversation that can't read the social cues to stop talking - like not noticing eyes wandering, yawning or sounds of agreement during a conversation. However, just as the voice assistant ignores these social cues, we are free to ignore the voice assistant also, so we just asked the voice assistant to 'shut up'. To understand this point better, compare the quotes from our participant interviews with the edited portions of this paper - our human conversations are littered with extra words and small talk, whereas a voice assistant's responses are simply a predetermined script. When personality is a salient concept in searching through voice assistants, the human-like presence almost tricks us into talking to it as if it were another human. When searching with keywords is just as effective i.e., 'Hey Google, weather forecast?', the faux personality induced small talk and conversational fluff is usually unproductive.

And the funny thing is that you can absolutely include all that fluff of conversational questioning with the Google Home Mini, but if you actually type into Google quite often, that can make it a less efficient search because it will search all the words in the question bar, but not just recognize that you're asking a question and answer that question, it won't always come through as a... as an efficient way to ask that, compared to if you just type in the keywords and it brings up the information you need.  
- Phoebe

Most users tried asking a voice assistant an information retrieval question and grew frustrated as the conversational agent starts to recite long paragraphs straight from Wikipedia. Even though users may want to move away from visual/written information searching towards verbal/auditory information searching by using voice assistants, they are still experiencing information written specifically for text-based visual mediums, which makes it difficult for their senses to adapt to this change, both aesthetically and cognitively.

### *Adjusting to new ways of searching and browsing*

In looking for information via libraries and databases users have grown comfortable with the textual, visual and temporal experience of using a search bar and browsing search results. In library catalogues, databases and search engines, keywords can open up endless possibilities. Users have also learnt to understand the bias of search results and the economic factors that impact the order in which the search results appear. For instance, search engine optimisation can be manipulated by companies to engineer the top search results (Latzer et al., 2016) and library catalogues are limited to the monetary capacity of the libraries, as well as their search interface.

The commercialisation of search results impacts what information we may find through these traditional mediums. Regardless of these factors, users are still free to make choices in furthering their information journey. They may click through pages of results, read abstracts, and consider the authority and relevance of the source. But when searching through voice assistants and interacting through conversation, we are presented with only one choice with little context (as well - little or no spoken references to where the information is sourced from). As Hao put it,

You can't really surf the web with it.  
- Hao

If the same users were to have a conversation with a friend, they would be able to ask for or offer the required information but also be able to provide the relevant context, such as source of origin, or the date the information was absorbed. Users could perhaps sense confusion or uncertainty with their conversation partner and offer more justification for the authority of our information without being prompt. Users could add to their conversation with emotional storytelling or visual aids. This isn't the case in conversation with voice assistants; well at least, not yet.

As users of voicebots are unable to browse search results in context, it is difficult to strategically search for information. Librarians and information professionals are experts at manipulating search strings to hone in on the most relatable search results (Bronstein & Nebenzahl, 2020). Manipulating filters, using Boolean operators or specific database characters like wildcards or 'exact phrase searching', all whilst knowing the politics behind databases and understanding the differences between subject specific databases. Information professionals also understand the importance of information literacy and encourage the use of frameworks like the C.R.A.P. test - which asks to consider the Currency, Relevance, Authority and Purpose of an information source (Knott & Szabo, 2013). But to the everyday user, advanced searching is not something they are all trained in - regardless of how many Google searches they may do. When searching via voice assistants, advanced searching is not an option. And users are prone to comparing their search experiences to our familiar libraries, databases and search engines. And in these comparisons, voice assistants fall short in satisfying their information needs and the presentation of choices.

...cause I think sometimes when asking her a question, you don't get an answer ..., or it doesn't understand you... But if you did a Google search for the same thing, you don't get replies, you do get website hits, so I guess the Google search can be a bit more fuzzy and allows that fuzziness so it gives you an approximate match...  
- Jenni

Not only does voice assistant information retrieval limit us in choice, it also doesn't allow us to discover related information. It hits a continual 'start and stop' barrier when it comes to completely fulfilling our information needs. In most interactions we are only fed one piece of information at a time, and the voice assistant loses the context of the question after the first answer, and hence is not able to maintain a conversation.

...she won't kind of keep the conversation open for continuing that same line of questioning, so if you want to... If it was like, if you ask a question about Anya Taylor-Joy, she will give you the answer. And then you'll have to be like, Oh, I actually wanted to know about this other thing. You have to ask about that specific person again... And I don't think you'd be able to ask, "what else has she been in? She [Google] might not understand that you're asking about the same actor from the first question or whatever, like it's less of a conversation and more of a - 'the answer has been given...

Next question'.

- Phoebe

Heinström (2005) described three broad personality traits to people's information seeking approaches: fast surfers, broad scanners, and deep divers, wherein fast surfers are 'characterized by minimum effort invested in information seeking and favoring easily available information sources' (p.240) and, 'deep divers are distinguished by use of considerable effort in order to retrieve high quality sources' (p.242). However, voice information retrieval does not have the affordances required for fast surfers or deep divers. At best, they support broad scanners, and even that has its limitations, for 'broad scanners are open to new information, extravert and spontaneous but also competitive in their orientation. This also increases the probability of accidental information discovery. The broad scanners were oriented towards seeking activity but less oriented to depth in the information content.' (p.241).

Another adjustment users must make when searching through voice assistants is that there is no back/undo option and their search history is not as easily available, unless they login to their search history online. Just like our human conversations that exist in singular moments (unless recorded), our information seeking experiences with voice assistants are ephemeral also. Their lack of accountability of time (i.e., past, and future conversations) is accounted for in a few ways. Firstly, the lack of accessible commands to review, return to past conversations, search tasks or follow-up questions through the voice interface. And secondly, the inability to continue a conversation through follow-up questions or comments as the voice assistant's memory is usually reset after each interaction when the voice assistants return to a neutral 'listening' setting.

...it's [like] a new Google search every time, whereas if I was talking to you, we remember we just spoke about that, and I can ask another question.

- Phoebe

In most human-to-human conversational interactions, the history of previous dialogues is kept and used to answer the user's questions enabling follow-up questions or references to earlier concepts (Zamani et al., 2022); this is only available in a very limited way with voice assistants.

However, voice assistants make information retrieval possible from anywhere within a physical space. No longer do we need to physically move to it or operate a machine. For many this level of accessibility is an afterthought, but for those users who may be physically or mentally impaired in some way, voice interaction can be highly useful.

...information wherever you are in the house - so like if I'm up in the bedroom, I don't have to go out into the lounge room to ask a question... 'cause we've got a speaker there too, so the access spreads into more areas and becomes more accessible.  
- Phoebe

Our study did not include any participants with accessibility needs, but this will be part of a future study.

## **Conclusion and Future Research**

Sometimes described as a *bad personal assistant* (Luger & Sellen, 2016), voice assistants are known for their utilitarian focus to achieve the goals of users such as retrieving information, requesting customer support, and conducting transactions (McLean & Osei-Fimpong, 2019). Drawing from our findings, we've shed light on the translations of information behaviour research from libraries, databases and search engines, to using voice assistants as a point of information retrieval. Our ethnographic approach aimed to extend beyond the uses and affordances of the technology, to zoom in on users, use, and usability of voice assistants. Our findings suggest that the human-like persona of voice assistants and adjustment to the affordances of voice interaction were salient obstacles in using voice-based information assistants.

### *Limitations*

This paper is exploratory in its scope as a case study focusing on the experiences of long-term users of voice assistants (6 months+). It relies on the recollection of experiences and therefore may miss some important points of the user's holistic experience. Other qualitative methods such as journaling may have captured greater data for analysis. As well, our small sample of participants do not allow us to derive generalisations about the use of voice-assistants; however, in ethnographic research, the core of the methodology is to make visible the lived experiences of a group of people who share a similar context. We do not seek to generalise their experiences to base our conclusions on, but to rather report on their individualistic and sometimes shared experiences (Martin & Hanington, 2018). Furthermore, whilst we tried to recruit a diversity of users from various cultural and socio-economic backgrounds, our participant pool did not have any users with any explicit impaired characteristics. We plan to address this in a future study.

### *Future Research*

From our *in-situ* interviews, we asked our participants to tell us about their everyday life with voice assistants and demonstrate to the researchers how they interact with their devices. With a

focus on information behaviours, further research could be conducted with new users of voice assistants, for our participants had had time to adapt their information behaviours and overcome any learning curve. Our study raises important challenges for the future of voice assistants, libraries, and search engines as information retrieval systems, including the presentation of search results in voice interaction compared to typical web searching, recreating the experience of positive serendipitous encounters in other information seeking settings, and the interference of perceived personality on the information behaviours of users.

This paper has focused on searching and browsing for information through voice assistants. There are other emerging findings from the wider study around the sociomateriality of the voice assistants and how they influence the human dynamics within a household; these will be published separately. These findings describe other phenomena that impact the way we connect to information via voice assistants, such as embodied and collaborative interactions, and conflicting beliefs and perceptions on human-like AI voice assistants. As we start speaking to the artificially intelligent beings that live in our homes, it is crucial to investigate how machines that speak with a human voice will change the way we interact with information and with each other.

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