

# Conversational Interfaces; are they changing us?

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## ABSTRACT

The conversational user interface has the potential to change the way we interact with devices, websites and apps. Recent developments in the fields of AI and natural language processing has made what has long been a scenario preserved for sci-fi movies become increasingly feasible. These developments come with a need to investigate the potential impact on human behaviour, both at a societal and individual level. The aim of this article is to explore the impact of conversational agent in the context of *gender roles, linguistics, learning, mental health, privacy issues* and *democratization*. Throughout the article, it is discussed what we stand to gain from this new form of interaction, and the potential unwanted consequences it may have. Findings imply that technology holds potential to reduce digital and social divides, as well as assisting in fields such as education, mental health and elderly care. However, care needs to be taken to avoid threats such as contributing to the maintenance of unhealthy gender roles and increased use of obscenity and profanity.

**KEYWORDS:** Conversational Interface, Voice assistant, Natural Language Processing, HCI

## 1. INTRODUCTION

Over the past few years it has been a rapid progress in artificial intelligence and natural language processing technology, opening the doors for Conversational User Interfaces. Conversational interfaces enable people to interact with smart devices using spoken language in a natural way (McTear, Callejas, & Griol, 2016). Major technology companies have invested in this type of interfaces, leveraging big data and machine learning to get as close to human intelligence as possible (Dale, 2016). Some experts claim that the conversational interface will revolutionize the way we interact with technology and potentially be as important as the change from the command line to the graphical user interface (Fichter & Wisniewski, 2017). CEO of Microsoft Satya Nadella has

compared the predicted shift to previous the introduction of the touch screen (Følstad & Brandtzæg, 2017).

Through all times technology has been a driving force for change in society. Introduction of new technologies does not only affect practical aspects, but can also result in changes in social structures and norms. If these mentioned predictions about the conversational interface are correct, this comes with a need to investigate the potential impact on human behaviour. This article takes an holistic approach in exploring the societal and social implications of conversing with machines. Existing research of the conversational interface in the context of gender roles, linguistics, learning, mental health and democratization is discussed, aiming to inform future research and developments in the field.

## 2. METHODOLOGY

The article employs the methodology of literature review to establish a fundament of knowledge that is employed in a discussion of the overall direction of the domain. The sources of information are obtained from the journal databases ORIA, Google scholar and Research Gate. Articles from some acknowledged industry magazines such as Medium and PC world has also been considered. Due to the fact that there is not one specific name for the concept of voice interfaces at this point, the terms used to find relevant articles were; “Conversational interfaces”, “Conversational Agents”, “Voice assistants” etc. These keywords were in turn paired with the various social aspects that was investigated. For example, “Conversational Agent” + “Linguistics”. Suitable synonyms were also considered regarding the words describing the social aspects. For example, the word “Linguistics” would be substituted with “Language” or “Accidence”. When it comes to the articles included, the selection process was based on the following criteria; the article has to be directly relevant to the topic, the article must be peer reviewed and the article must be published after 2008. The time limitation was placed due to the rapid changes of the domain. Some older articles were included, to aid contextualisation. All the included references were obtained lawfully and are cited correctly.

## 3. THE CONVERSATIONAL INTERFACE

A conversational interface is a way of interacting with a computer in natural language (Fichter & Wisniewski, 2017). The conversational interface has gained massive interest in the last years, led by the introduction of voice assistants, most significantly; Apple’s Siri, Microsoft’s Cortana, Amazon’s Alexa and Google’s Assistant (Dale, 2016). These voice assistants run on smartphones, but also purpose-built speaker devices meant to be placed inside the home. The assistant constantly listens for a key word to wake it up, and once it hears that key word, it

records the user’s voice and sends it to specialized backend, which processes and interprets it as a command (Hoy, 2018). The various assistants have different functionality and are continuously expanding the number of available commands. However, the core functions are the same; you can ask it for information, play requested media or complete tasks with various connected services and devices. (Hirschberg & Manning, 2015) credit the recent advances in natural language processing to the following advances; “a great increase in computing power, the availability of massive amounts of linguistic data, the development of highly successful machine learning methods and an increased understanding of the structure of human language and its deployment in social contexts” (Hoi, 2018, p.82).

## 4. LANGUAGE

Humans apply linguistic style matching in their social interactions (Niederhoffer & Pennebaker, 2002). This means that people try to match the language patterns of the people they are talking to. This applies to the kinds of words used, the number of words per turn and nonverbal cues. For example, if one person interacts in brief bursts, the other tends to follow. Similarly, the overall linguistic complexity and tone covary between the participants. A study conducted by (Hill, Randolph Ford, & Farreras, 2015) analysed how communication changes when people communicate with a digital agent as opposed to with another human. Their results indicate that when people communicate with a digital assistant, they tend to perform twice as many exchanges as when talking to another human. However, the exchanges include fewer words and a limited vocabulary. The researchers argue that these findings indicate that people are adapting their communication to match that of the digital assistant, in the same way that people adapt their language when conversing with children or non-native speakers implying that linguistic style-matching is taking place in conversations with voice assistants.

Large, Clark, Quandt, Burnett, & Skrypchuk, (2017) explored how humans interact with a voice assistant, applying recognized linguistic techniques, such as discourse and conversation analysis, normally reserved for interpersonal investigation. The results indicate that interactions with the voice assistant were fundamentally social in nature, with participants treating the assistant with equal social status and expecting high-level cognitive processing. For example, the participants used filler words, referred to previous topics in the conversation and used vague words and gesticulations (Large et al., 2017).

Multiple studies (Miner et al., 2016) demonstrate that human sentiment-related interaction norms persist in human-agent dialogs. However, the norms are weakened, proven by the fact that inhibition towards use of profanity is greatly reduced (Miner et al., 2016). In addition to use of profanity, many of the conversations were also sexually explicit (Hill et al. 2015). The authors speculate that the reasons for this behaviour were the users testing the limits of the digital assistant's conversational domains. At this point no research has explored the consequences of agent abuse. Of pressing concern is determining whether and to what degree agent abuse has an impact on the abuse of human beings (Brahnam & De Angeli, 2012).

Because Voice assistants respond to verbal commands, they are very accessible for children (Steele, 2018). Unlike the graphical user interfaces, the conversational interface does not require them to learn new gestures or even know how to read. By taking after their parents, they will soon know how to activate the assistant and make it perform tasks. However, politeness and niceties like saying "please" and "thank you" are not rewarded in conversations with voice assistants. With the current state of NLP capabilities, it rather pays to be direct and cut away courtesies (Steele, 2018). If it comes to the point where conversations with machines are as frequent as conversations with humans, it is important to address if this could affect the

manners of people growing up with voice interfaces.

## 5. LEARNING

Many educators acknowledge that the application of technology can lead to improved student learning and better teaching methods (Griol, Sanchis, & Molina, 2018). With the growing maturity of conversational technologies, the possibilities for exploiting this in education are receiving greater attention (Griol, Baena, Molina, & de Miguel, 2014). Some examples of the current applications of voice technology in the context of learning are question-answering applications, conversation practice for language learners, pedagogical agents and learning companions (Griol et al., 2018). However the application that is receiving the most attention are Conversational Intelligent Tutoring Systems (further referred to as CITS) (Griol et al., 2018). CITS are computerized learning systems which adopt artificial intelligence to each individual's characteristics, such as existing knowledge and learning styles (Latham et al., 2011). CITS incorporate human-like natural language interfaces which allow learners to explore and discuss a topic, supporting the constructivist style of learning used by human tutors (Latham et al., 2011).

Individual tutoring has shown to be a much more effective form of instruction than traditional one-to-many classroom instruction (Juárez-Ramírez et al., 2013). However, appointing one instructor for each student is rarely economically feasible. Could CITS propose an opportunity to incorporate the subject expertise and the teaching skills of the best instructors in a software system to provide some of the benefits of one-to-one tutoring in an economically sustainable matter? Previous research have demonstrated that by CITS can accelerate the learning process, facilitate access to education, personalize the learning process and supply a richer learning environment (McTear, Callejas, & Griol, 2016).

It has been developed several CITS (Latham et al. 2011; Griol et al., 2014) that adopt tutoring to individual students. The results are indicating that the students whose tutoring adapted to their learning styles achieved on average 12% more correct answers than the control groups. According to the researcher, students reported that the adaptation provided by the system and the natural communication that it provided had a very positive impact on the learning outcomes and satisfaction (Latham et al. 2011; Griol et al., 2014). This satisfaction can be linked to students feeling more comfortable and relaxed when conversing with bots instead of peers, because they become less self-aware and insecure of being wrong (Shawar & Atwell, 2007).

Even though the research on CITS are promising, there are few existing solutions on the market today. CITS are complex and time-consuming to develop and the ones that do exist typically rely on a variety of components and usually include specific modules developed ad-hoc by the researchers, which make scalability difficult (Griol et al., 2014). With the rapid advances in the field of conversational interfaces, this will probably become more feasible in the near future. Ultimately, it is important to stress that the human resource is the essential factor in teaching because of the teachers level of education and training, as well as the human empathy and intuition that is impossible to mimic in a CITS (Duță & Martínez-Rivera, 2015). Additionally it is essential for students to converse with their peers and be exposed to different situations in order to develop as humans, and CITS should only be seen as an additional tool.

## 6. MENTAL HEALTH

In the field of mental health, conversational agents are referred to as a type of Behavioral Intervention Technology (further referred to as BIT). BITs comprises the use of technological features to deliver psychological and behavioural health treatment (Mohr, Burns, Schueller, Clarke, & Klinkman, 2013). According to Mohr et al. (2013), 75% of American primary care patients

with depression can identify one or several structural or psychological barrier that prevents access to treatment. BITs are a research priority because of its potential to overcome barriers such as geography, cost, and absence of skilled clinicians, and this way reach people otherwise not be able to access care (Miner et al., 2016). One particular field that has shown great potential in this context is in assistance for people with dementia (Van der Roest, Wenborn, Pastink, Dröes, & Orrell, 2017). Dementia is a progressive disease, which involves loss of cognitive abilities (such as memory, problem solving, language and self-management) (Wolters et al., 2016). Memory aids such as calendars and reminders has for many years been an important and effective part of dementia treatment (Bourgeois, Dijkstra, Burgio, & Allen-Burge, 2001). Intelligent cognitive assistants (further referred to as ICAs) are memory aids using AI to dynamically adapt the support to each individual user based on the extent of cognitive impairment, stress levels, and the tasks that users are carrying out (Wolters et al., 2016).

A study conducted by Wolters et al. (2016) compared two existing conversational ICAs with two different approaches to cognitive assistance. The two systems they compared differs in that one of them are completely system-initiative and talks users through each step, the other is user-initiative, intervening only when problems are detected. The conclusion of the comparison was that the system that actively steered the conversation were most successful in assisting the users. These findings helped develop a new solution for a conversational ICAs that support dementia users with complex tasks, such as interacting with technology. The results from the testing of this solution on dementia patients proved that participants saw clear benefits, particularly valuing the independence the ICA could give them (Wolters et al., 2016).

Another area where conversational interfaces has been explored are in the context of loneliness and social isolation in older adult populations. (Ring, Barry, Totzke, & Bickmore,

2013) developed a conversational agent to provide longitudinal social support to isolated older adults. Results from their study showed that an in-home conversational agent is not only accepted by isolated older adults but can also be used to help avoid loneliness. An important finding was that the system had the ability to pick up and manage the emotional state of the users through dialogue (Ring et al., 2013). This suggests that an agent could be designed with a system that in real time reacts to the user's emotional state, and in turn provide management and potential treatment for emotion related disorders (Ring et al., 2013). Similarly to the study by Wolters et al. (2016), these results also highlighted that when the agent proactively draws users into interactions, it is more effective than when the agent passively relies upon users to initiate interactions.

An aspect that has been pointed out by several researchers (Ring et al., 2013; Wolters et al., 2016; Miner et al., 2016) are the social stimulation that the conversational agent can provide to patients. Observations in several of the studies indicated that the patients developed a social bond and a sense of companionship with the agent. This however raises the issue of false expectations. When a user forms a social relationship with the agent, there is a risk of expecting too much, which can lead to disappointment if the agent cannot deliver adequate dialogues. Thus an important future direction of research is how one can make the agent facilitate communication between user their social network to strengthen and maintain relationships (Ring et al., 2013). Another issue with these new forms of delivery of assistance, is that they reduce the "band-width" of the therapy. While BITs can extend care geographically and make it more efficient economically, it has been argued that it cannot replace traditional treatments because of the lack of human presence, which can decrease therapeutic efficacy and lead to difficulties in managing emergencies and crises (Mohr et al., 2013).

## 7. GENDER ROLES

Leading companies such as Apple and Amazon, have launched their voice assistant products with female voices and, in some cases, female names. Historically, the role of a personal assistant (which essentially is what a voice assistant is), has been dominated by women (Steele, 2018). In modern society, equality between men and women is something that is continually being worked for worldwide, and in some countries it is statutory. The Norwegian Equality and Discrimination Act of 2017 defines equality as "equality, equal opportunity and equal rights" (Lovdata, 2018). By introducing digital assistants that are based on traditional gender roles, could this contribute to the maintenance of unhealthy gender differences in society?

In a study from 2008, (Newman, Groom, Handelman, & Pennebaker, 2008), analyzed a body of over 14,000 text files from 70 separate studies, to explore the differences in language use between men and women. Their analysis reveal significant differences in the way that men and women use language, both in terms of *what* they say and *how* they choose to say it. Most significantly, men and women use "function words," such as pronouns, articles, and prepositions, in different ways. Women also use "cognitive" words such as *understand*, *know* and *think* as well as "social" words, words that relate to other human beings, more than men. According to (Hannon, 2016), the use of the pronoun "I," is a more frequently used by people with lower social status in a relationship. He goes on to argue that it can be a sign of lower self-esteem, and is often seen in relation to taking personal responsibility for mistakes or removing weight from an opinion.

These language patterns are largely being replicated in the female conversational agents on the market today (Brahnam and De Angeli, 2012). An example is Apple's Siri, that will respond with "Sorry, I'm not sure I understand", if it is not able to come up with an answer, taking full responsibility for the misunderstanding. In

contrast, in the design of a conversational interface for IBM's Watson, one of the most intelligent AIs in the industry, which famously won "Jeopardy" and is assisting in oncology (McTear, Callejas, & Griol, 2016), a male voice and language pattern were chosen. The tone of voice of Watson is self-assured and uses short definitive phrases, typical of male speech (Newman et al., 2008). It has been argued that humans tend to prefer leader figures with lower pitched voices (Klofstad, Anderson, & Peters, 2012). Research also suggest that female voices are perceived as assisting users solve problems by themselves, while male voices are perceived as authority figures who directly gives answers to their problems (Nass & Brave, 2005).

Building on social psychology research, Brahnham and De Angeli (2012) analyzed the persistence of gender stereotypes in conversations with voice assistants. Their results indicate that gender stereotypes tend to affect the interaction with a CUI' more related to style then to the content of conversation. Further, the study indicates that people attribute negative stereotypes to female-assistants more often than they do male-assistants, and female-assistants are more often exposed to sexual language and abuse. By projecting the same gender biased language patterns in a digital assistant, female AI personalities are positioned with a lowered status in the human-machine relationship, maintaining gender inequalities. Hannon (2016) suggests that developers of conversational interfaces has the power to avoid this trend, by considering other language patterns in the design of conversational interfaces.

## 8. PRIVACY

Novel technologies comes with new ethics and privacy implications. Conversational interfaces are no exception. Interaction in natural language with conversational agents is a context where ethical and privacy challenges will occur (Følstad & Brandtzæg, 2017). Particularly exposed are smart speakers like Google home and Amazon Alexa, as they are implemented in consumers

households, as part of what is referred to as smart homes. As these devices often lack the computational power to process the user's speech, they communicate with a cloud counterpart to provide the desired output (Hoy, 2018). To function as desired, these devices must be listening at all times so that they can respond to users. The major companies all insist that their devices are not recording unless users initiate a command to wake them, but there has been examples of malfunctioning devices recording at all times and sending those recordings back to company servers (Wueest, 2017). Recording and sharing this form of information could have serious consequences to the privacy of individuals.

According to a security report conducted by security experts Symantec (Wueest, 2017), the biggest threat to the security of a voice-activated smart speaker is the other people who can access it. Anyone with access can ask it questions, gather information about the accounts and services associated with the device, and make it perform tasks. This implies a major security risk because these devices can read out calendar contents, emails, and other sensitive information (Hoy, 2018). Unauthorized users can also control sensitive home automation systems through the device; for example, there has been an instance of a person opening a garage door while standing outside the home of a stranger (Gao, Chandrasekaran, Fawaz, & Banerjee, 2018). TV and radio are also able to activate voice devices, causing them to perform task or even adding items to online shopping carts, which eventually might persuade users to buy products (Hoy, 2018). Følstad & Brandtzæg (2017) express that misuse of voice assistants for persuasive purposes may have important societal implications such as affecting individuals' opinions in undesirable ways.

The majority of smart devices have no mechanism for user authentication other than simple voice recognition. However, measures are being taken to minimize privacy risks. Google has upgraded its security system to include voice

printing, which uniquely identifies each user by voice and prevents the device from reading out personal information (Google, 2018). Other actors are working to deploy similar voice printing systems and developing better security systems for smart speakers are a field of great interests for researchers (Diao, Liu, Zhou, & Zhang, 2014). As the security of artificial intelligence and smart products is not yet clearly defined, it is suggested that voice assistants, at this point, are not trusted with sensitive information (Mallios, 2018).

## 9. DEMOCRATISATION OF TECHNOLOGY

History shows that new technologies, when introduced, can create new digital divides and differences across gender, age, and social status (Brandtzæg, Heim, & Karahasanović, 2011). The introduction of conversational interfaces, however, has the prospect of making technology and digital services more available to a greater part society. Making digital services available through natural dialogue, has the possibility of lessening digital divides because it requires very little technical understanding and experience from the user (Følstad & Brandtzæg, 2017).

For many people, the ability to read and type is hindering access to technology. Visually impaired elderly are a group that are particularly prone to digital divides (Ho, 2017). Research has shown that this group display higher prevalence of anxiety, depression, and have poorer quality of life (Cimarolli et al., 2015). It has been shown that introducing the Internet to the elderly can help to promote psychological well-being, contributing to their sense of empowerment and independence (Mellor, Firth, & Moore, 2008). Accessing the internet through mediums such as computers and smartphones require a certain level of vision and manual dexterity, which can be a barrier for people in this group. The conversational interface are able to bypass these constraints, by exploiting the users speech and hearing functions.

An issue with the commercial conversational interfaces of today are that they are not diverse. They are typically set up following a one-size- fits-all approach, meaning that all users, regardless of needs and preferences receive responses in the same language, based on the same algorithms (Følstad & Brandtzæg, 2017). This raises the question of whether this can introduce undesirable biases and make the devices favour certain parts of society. Another question is if having a standardized conversational partner for can have an effect on the diversity? The developers of these devices has a lot of influence on these questions and the knowledge and user research and analysis by HCI researchers and practitioners will be essential in creating a more democratic technology (Følstad & Brandtzæg, 2017).

## 10. CONCLUSION

This review has taken a holistic approach to examine the societal and individual implications of conversational interfaces, to inform future research and developments in the field. The effects of conversational interfaces has been categorically examined and discussed in the contexts of linguistics, gender roles, psychology, learning, privacy and democratization. Findings indicate that human social norms persist in conversations with conversational interfaces. However, Inhibition towards use of profanity and sexually implicit language is greatly reduced. It also pays to be direct and cut away manners. Research is needed to establish whether and to what degree this could impact manners and inclination towards abuse of human beings. In the context of learning, research has demonstrated that Conversational Intelligent Tutoring Systems show promising effects on learning outcomes and learning experiences. However, it is important to stress that the human empathy and intuition are the essential factor in education. In the field of psychology, the use of conversational Intelligent cognitive assistants, that adapt to individual patients in dementia treatment has shown potential. These systems are most effective when they proactively draws

users into interactions. The conversational interface can provide social stimuli for patients, however if the agent cannot live up to the patients expectations it can lead to disappointment. An interesting future direction of research is to how one can make the agent facilitate for human to human communication. Most commercial voice assistants have female voices, language patterns and female names. Researchers argue that by introducing digital assistants that are based on traditional gender roles, it could contribute to the maintenance of unhealthy gender differences in society. It is claimed that developers of conversational interfaces has the power to avoid this trend. The conversational interface also comes with new ethics and privacy implications. The security of conversational interfaces is not yet clearly defined and security systems are a pressing issue for researchers. Finally It is argued that the conversational interface, by making services available through natural language, has the potential to democratise technology. For people with visual or physical impairment, the conversational interface offers an alternative way of obtaining technology. In the same way, for people with economical or geographical barriers to education or health treatment, the voice assistant present significant possibilities.

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