The design & evaluation of interactive systems with perceived social intelligence: five challenges

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Abstract

This paper reflects on discussions within the Social Intelligence for Tele-healthcare (SIFT) project. The SIFT project aims to establish a model of social intelligence, to support the user-centred design of social intelligence in interactive systems. The conceptual background of social intelligence for the SIFT project is presented. Five challenges identified for the design of socially aware interactions are described, and their implications are discussed.

Keywords: Social Intelligence, Interaction Design, Evaluation, UCD.

1 INTRODUCTION

Social intelligence has been postulated as a person's, "ability to get along with people in general, social technique or ease in society, knowledge of social matters, susceptibility to stimuli from other members of a group, as well as insight into temporary moods or underlying personality traits of strangers" [32], p. 44). The breadth of this description and many others since has led to ambiguous and varied interpretations of social intelligence. For example, [31]'s original description of social intelligence was more specific to an individual's ability in their direct environment, to understand and manage people and adapt in social interactions, whilst [5] redefined social intelligence to refer to an individual's knowledge of their social world. Acknowledging this ambiguity, [13] (p. 199) describe two distinct interpretations, "the [social] intelligence that an individual needs to effectively participate in a society", and "the [social] intelligence that a society as a whole can exhibit." This paper is concerned with the application of social intelligence to the design of interactive systems.

For much existing user-system interaction the user chooses when to interact with technology. This ensures that the user understands what initiated the system action. It has been postulated that future technology will become ubiquitous, in which, "machines fit the human environment instead of forcing humans to enter theirs" and sensors will be embedded, unnoticeably within everything in the environment [34]. In a review of many applications for this technology, [21] identified common characteristics which forecast technology that: (i) is aware of it's own state and that of related systems, (ii) is aware of the user's intentions, tasks and feelings, and (iii) can autonomously adapt its behaviour spontaneously on context changes. This is a paradigmatic shift from existing user-system interaction [2], as systems will have the capacity to initiate interaction, intervene and carry out tasks independently of the user. Nonetheless, it is imperative that system actions continue to be understood by the user. Otherwise, the user will become frustrated, the benefits of future technology will be reduced, and adoption will be inhibited. Therefore, it is important that interactive systems are designed to behave in a manner that is expected and understood by the user.

Technology that behaves in a way that adheres to social conventions, indicative of social intelligence, are perceived as social actors [9], [28]. Social intelligence could be applied to interactive systems design to support user-system interaction in future technology. The ambiguous and broad nature of social intelligence does not make its application to design intuitive however. [25] illustrates this by identifying three aspects of SID in an attempt to provide a structure to the SID field of research: (i) interaction in social discourse; (ii) community media and social interaction in the large; and (iii) social artefacts. Yet, it is not known fully in what capacity there is a need for social intelligence, or what role and effect social intelligence will have when imbued in technology.

This paper reflects on discussions within the Social Intelligence for Tele-healthcare (SIFT) project. The SIFT project aims to establish a model of social intelligence, to support the user-centred design (UCD) and evaluation of socially intelligent interactive systems. The paper presents the conceptual background of social intelligence for the SIFT project, and five challenges that have been identified to achieve the project goals. Implications are discussed.

2 CONCEPTUAL BACKGROUD OF SOCIAL INTELLIGENCE

The conceptual background of social intelligence is now presented. This will impact the embodiment of social intelligence in interactive systems, and the effect it will have on user-system interaction.

2.1 SOCIAL INTELLIGENCE IN INTERACTIVE SYSTEMS IS WORTHY OF EXPLORATION

When developing socially intelligent interactive systems, it is assumed that social attributes are useful. [28] reported that the user perception of social attributes in a computer led to users liking those computers more than when these attributes were not perceived. Their *media equation* describes a human's response to media as, "fundamentally social and natural," in which everyone expects media to obey a wide range of social and natural rules [28] (p. 251). In reality, interactive systems may not understand social and natural rules of interaction but what people perceive to be true is more influential than the objective reality [28]. Whether a computer can have a personality or not does not matter, people will respond socially on the perception of personality alone [28]. This was reported to be true for manners (e.g., politeness, interpersonal distance, flattery, judging others and ourselves), emotion (e.g., good vs. bad, negativity, and arousal), social roles (e.g., specialists, team-mates, gender, voices, and source orientation) and form (e.g., image size, fidelity, synchrony, motion, scene change and subliminal images). Additional reasons for embedding these characteristics into technology have been reported since, examples include: users rating computer agents using humour as more likable, competent, and cooperative [23]; users rating a computer that uses reciprocal, deep self-disclosure in text-based conversation as being more attractive, which led to users divulging more intimate information and being more likely to purchase the product [22]; and, users rating a computer whose synthesised voice personality matched their own, as more attractive, credible, and informative [24]. [7] reported that social language (small talk) had a significant effect on users' perceptions of an intelligent agent's knowledgeableness and ability to engage users, to trust, to be credible, and how well they felt the system knew them. Most interestingly, these systems tried to elicit the perception of personhood, but [27] found that good etiquette in social language of a non-personified, flight-simulator system resulted in more successful interaction and greater trust in the system.

These examples ([7], [22], [23], [24], [27] and [28]) suggest that designers can imbue interactive systems with particular social attributes to make systems appear more socially intelligent, which in turn will make these systems appear: more likable, competent, cooperative, attractive, credible, informative, knowledgeable, and to improve successful interaction and trust. There are advantages to these socially intelligent perceptions of technology. For instance, a user's trust in an automated system is an indicator of how accurately the user understands the system [19], and is also directly related to technology usage [4]. This is even postulated when technology has social characteristics without attempting to elicit a perception of personhood [27] (i.e., safety critical systems and existing consumer products). Therefore, social characteristics in consumer products are worthy of further exploration.

2.2 THE INDIVIDUAL, THE ENVIRONMENT & CULTURE INFLUENCE SOCIAL BEHAVIOUR

When considering social behaviour, [33] suggested that an individual has internal cues that vary in terms of their ambiguousness for a respective task. These may include somato-sensory information, feelings, emotions, personality, or mood. These in turn will influence the social perception of a situation and, depending on the desired goals of an interaction and the rules that govern the understanding of appropriate responses, choice of appropriate social behaviour. These were named the indeterminate individual factors that influence social behaviour.

[30] reported two cues that influence social behaviour, that help determine the possible outcomes of an interaction. The first is the other individual(s) in the interaction who will influence social behaviour, e.g., the relationship, perceived status and previous history with the other individual(s). The second is the situation or context of the interaction. This is not only the physical situation or context but also the social context, e.g., private, public or work situations; a busy, calm, familiar or strange location. It can be assumed then, that social behaviour following an interaction with another individual is also influenced by environmental or contextual factors. In [33]'s cognitive performance construct of social intelligence, these factors are described as indeterminate environmental factors.

Social intelligence is also culturally bound [5]. That is, social behaviour is influenced by the social actor's cultural understanding. [12] argues that social intelligence can not adequately explain effective interpersonal behaviour across cultures, and, therefore, suggests cultural intelligence as a construct distinct from social intelligence. Nevertheless, the understanding and familiarity of culture undoubtedly influences an individual's perception of appropriate social behaviour. Thus, cultural understanding also influences social behaviour.

In addition to social knowledge [33], an individual's social behaviour is influenced by:

1. The indeterminate individual characteristics of a social actor, e.g. personality, mood, age, experience.
2. The indeterminate environmental factors of social interaction, e.g. location, event, history.
3. Understanding of the culture in which social interaction takes place, e.g. etiquette, traditions, values.

These influences on social behaviour must be accounted for when designing socially intelligent systems. Criticism of the psychometric attempt to operationalise aspects of social intelligence for comparative and performance purposes (e.g., [14]) suggest that the influence of these indeterminate factors on social behaviour make measuring social intelligence futile. That is, any attempt to measure an individual's social intelligence, as a prediction of social behaviour in a situation, is in vain, as there are infinite situations. This same criticism could be applied to social intelligence in design. Nevertheless, given a specific interaction, context and culture as a starting point, appropriate social behaviour can be established to support the design of socially intelligent systems, e.g. [10].

2.3 THE INDIVIDUAL, THE ENVIRONMENT & CULTURE INFLUENCE USER PERCEPTIONS

Given that the individual, the environment and culture influence social behaviour, we can assume that an individual's social intelligence will influence their perceived social intelligence of another. For example, if Person A finds Person B rude as a result of a particular interaction, Person A may perceive Person B to have less social intelligence than himself. Nonetheless, another individual, Person C, may not perceive the identical behaviour to be rude. The differences in perceived social intelligence could be due to any or all of the factors identified in Section 2.2. First, this may be *individual* characteristics that are independent of the situational factors, e.g. Person A may be more sensitive than Person C due to their mood or previous experience. Second, the perceived difference between Person A and C could be due to *environment* understanding, which result from differing perceptions of what is acceptable social behaviour. Finally, the knowledge that governs the perception of non-rude social behaviour may be *cultural*, e.g. it may be acceptable to be direct when in the Netherlands but in England being direct may be considered 'rude' or 'harsh'. It is important to assume that the individual, the environment, and culture will influence perceived social intelligence towards another social actor.

The threshold between what is perceived to be appropriate social behaviour is not the same across individuals or situations. When this is applied to interactive systems design, people may perceive and expect different social behaviours from the same consumer product and application. Would an individual accept a DVD recorder that declines to record a television programme because the DVD recorder has a particular opinion about the programme? Contrarily, a device for monitoring a diabetes patient might exhibit advisory behaviour, but this too may encroach on what an individual deems as acceptable social behaviour. Establishing the user's acceptance of a system's social behaviour requires the understanding of individual, environmental and cultural perceptions of social intelligence.

2.4 THERE WILL ALWAYS BE INDETERMINATE JUDGEMENTS

In contrast to [13]'s interpretation of social intelligence research, [29] used two different aspects to structure social intelligence research: (i) the cognitive, and (ii) the behavioural emphasis. The cognitive component is the ability to understand other people, whilst the behavioural emphasis is the ability to apply the cognitive component in interaction, therefore, to successfully interact with other social actors. [33]'s cognitive performance construct of social intelligence acknowledged that resulting behaviour in a situation also depend on indeterminate individual and environmental factors. Therefore, it cannot be assumed that understanding the situation (the cognitive component) will lead to the most appropriate social behaviour, as carrying out the action is dependent on behavioural ability. In addition, the most appropriate behaviour may not be determined until an interaction is in progress.

When applied to interactive systems design, it cannot be assumed that a system that can understand individual and environmental factors (the cognitive component) will lead to performing the most appropriate social behaviour (the behavioural component). However, when designing interactive systems to support specific tasks in stable situations and social actors, the number of suitable social behaviours will be reduced substantially. This is how some existing socially intelligent systems are being developed. For specific tasks and situations, [10] showed that reproducing social intelligence in robots may be perceived successfully in cases tested for the original system development, but performance was poor in other situations. Given that individual, environmental and cultural factors influence the appropriateness of one's own, and perceived social behaviour, it can be assumed that knowledge of these factors will support the design of appropriate social behaviour. However, there will always be some indeterminate judgements, when situations have or have not been tested or predicted in development. Therefore, if systems are to be developed for more than one situation, they must evolve within interactions and across situations.

2.5 Social intelligence is fundamentally different to usability

As an element of design, social intelligence is fundamentally different to usability. To support UCD it is important to clarify what the differences are. Usability is the, "extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" [17]. The objective dimensions, effectiveness and efficiency, are distinctly different to social intelligence which, like the satisfaction dimension, is subjective in nature. Satisfaction measures, "the extent to which users are free from discomfort, and their attitudes towards the use of the product" [16]. Therefore, user satisfaction is a result of the interaction with the system, and is a reflection of how the interaction left the user feeling. It is not, then, a system property but rather the effect system properties have upon the end user who is interacting with this system. Examples of [20]'s usability satisfaction questions include, "I felt comfortable using the system" and, "I like using the interface of the system." Note the focus is on *how I feel* when interacting with the system. In contrast, social intelligence is the user's subjective perception that is the result of interacting with the system, and is attributed to the system. The perception of the social characteristics of a system should not reflect the feeling that the user was left with following an interaction but a perception attributed to the system. This is a distinction between the feeling that a system leaves you with (how I feel), and the perception toward a system (the system was polite).

Nonetheless, usability will influence perceived social intelligence. Manipulating an interactive system's usability characteristics affects the system's ability to communicate information to the user, measured by efficiency, effectiveness and satisfaction. This will also impact social intelligence, which is also perceived by the user. [27] have shown that good etiquette in the social language of a non-personified, flight-simulator system resulted in more successful interaction and greater trust in the system. This finding suggests that social characteristics will influence task performance (effectiveness) in the same way that usability does, indicating that usability and social intelligence are not independent. When applied to the design of interactive systems, the difference between usability and social intelligence will influence the methods that can be followed in design. This directly impacts Challenge One.

3 Challenges for social intelligence in design

3.1 Challenge One: Supporting UCD for social intelligence

Designer's need to know what effect social characteristics will have on user-system interaction, to ensure that socially intelligent design will be efficacious. [11] reported three approaches for UCD, dependent on the type of product being developed, and differentiated by the stage and purpose of users being actively involved. When developing generic products, UCD is carried out *for users* through the provision of existing theories and knowledge about the user. When developing local or bespoke products, the design is carried out *by users*. For this, the user is consulted directly early in the UCD process with participatory design methods. For customisable products, for which it is deemed that users have, "good local task reason, as well as value and aspiration reasons for wanting to work in other ways" [11] (p. 1672), the UCD process is *for users* and *by users*. The design is therefore deferred and the product offers an amount of customisable capability for users to implement. Many UCD methods to incorporate in these approaches were illustrated by [26], who put forward a continuum of user roles in design from a user simply being a passive subject of observation, through to an active agent, to being an empowered partner as a co-designer.

Social intelligence is bound by the influence of indeterminate individual and environmental factors, and culture on social behaviour, and their bearing on perceived social intelligence. Consequently, when supporting the designer no specific guidance other than a high level description of social intelligence will be useful, unless systems are designed for identical contexts. It is desirable, then, that socially intelligent systems are bespoke and customisable for particular contexts. For this, [11] suggested UCD *for users* and *by users*. However, this may not be efficacious for socially intelligent systems. Participatory design has a moral and pragmatic proposition [6]. The moral position, from Scandinavian democratic principles, states that the shared design of the workplace would lead to an improved work situation [15]. The pragmatic proposition is that by including the user directly in the design process, the design will be more successful. In taking part in the design process, the user can offer preference, expert opinion and personal perspectives regarding the activity that the design will support. However, asking users about social intelligence may not achieve such reflection. Social intelligence may not be perceived by users in early prototypes, due to crude technology implementation. There is also a question over who should customise a socially intelligent system. [33]'s model of social intelligence assumes that resulting social behaviour depends on five facets of social intelligence, one of which is social memory. Social memory is the storage and conscious retrieval of both episodic (i.e., past experiences) and semantic memory (i.e., words meanings, facts, general knowledge) [18]. Given this, it is not the user that should customise an interactive systems social intelligence but the interactive system, as social intelligence must be learned, grow and evolve over time.

Establishing how and when to involve the user in UCD is always a challenge. The UCD process for consumer products does not normally require considerations typical in the design of autonomous industrial systems. Therefore, designing socially intelligent systems for the user, in the home, will require a review of suitable UCD methods.

3.2 Challenge Two: Evaluating social intelligence

Typically when evaluating a subjective construct, a psychometric instrument is developed through a specific process of defining the construct, establishing construct validity, and testing reliability. When completing such a measure individual factors will influence responses. For social intelligence, one's own social intelligence will impact the perceived social intelligence of an interactive system. This suggests that prior to conducting an experiment to measure the perception of a system's social intelligence, it may be important to measure a user's social intelligence. Sampling users with a reported high social intelligence may give more sensitive results, as you would expect an individual with high social intelligence to be more receptive to social intelligence of another. This may not be efficacious however, as the target user group may not be highly socially intelligent. An individual will only know the social rules for familiar environments. Through experience an individual will develop a feeling for what is and is not appropriate behaviour. Therefore, when evaluating social intelligence in interactive systems, it is imperative for the subjects to be familiar or experienced in the intended use context. This will ensure that the findings are indicative of appropriate social behaviour for that particular use context.

Another consideration for evaluation is that a socially intelligent system will not be a static system. One would expect the system to evolve over time, and this will require an evaluation over time. Existing UCD methods result in an evaluation for a specific point in time. The nature of social intelligence suggests that this will not be sufficient, as social intelligence depends on many factors, including social memory and previous interactions, necessitating evaluations of the system as it evolves. To overcome this, as the system evolves, the systems should have the ability to calibrate the social intelligence perceived by the user.

When completing an IQ test, an individual's score can be compared to the greater population by creating normative scores based on population data. To create a normative measure for attributes of a system the measure must be developed by evaluating the social intelligence of many systems. For example, the resulting social intelligence score of one system may be different to another. A large sample of systems would have to be subject to evaluation, and with a large sample of the population. The advantage of a normative measure is the ability to compare different systems. One measure of social characteristics in interactive systems is the Social Behaviour Questionnaire (SBQ), developed to evaluate social behavioural characteristics of a robotic interface [9]. However, given the very specific embodiment in their study, many of the SBQ's items would have to be disregarded if it was used with another system. An abridged version of the SBQ would require construct validity and reliability to be established. Therefore, it is suggested that new *modular* measures should be developed to facilitate evaluation of social intelligence across embodiments and contexts, and for systems to have the ability to calibrate social intelligence in situ. Otherwise measures have to be sensitive to specific social interactions, contexts and cultures.

3.3 Challenge Three: Understanding the effect of social characteristics.

Many different social characteristics have been reported to impact the interaction between the user and an interactive system ([7], [22], [23], [24], [27] and [28]). It has not yet been fully established what impact the embodiment of different social intelligence characteristics will have on user-system interaction, or whether the same effects can be observed across contexts. To support interactive systems design it is essential to know what effect particular characteristics of social intelligence will have on user-system interaction and how this effect changes depending on the embodiment. For example, a polite humanoid robot will lead to a different expectation than a polite washing machine. This also depends on individual and environmental factors. For any user-system interaction, Person A may have different expectations for interactive systems that support different tasks and contexts; or Person A may have different expectations from Person B, despite being partners and living in the same home.

[10] proposed some high level guidance for the development of sociable robots, however, it is specifically stated that all actions are bound by the context. Therefore, a set of rules for the effects of social intelligence characteristics in interactive systems must be embodiment and context bound. Indeed other authors have proposed models of social characteristics and the effect on interaction, e.g., body language [3], social language [7]. However, there is little understanding for social systems that are not personified, e.g. [27]. The challenge then is to understand the effects of social characteristics in interactive systems depending on embodiment and context.

3.4 Challenge Four: Ethical considerations for social intelligence

When designing socially intelligent interactive systems, based on [7] and [27], one hypothesis could be that social intelligence will improve trust. Trust is an indicator of how accurately the user understands a system [19], suggesting a second hypothesis: social intelligence will support intuitive usage. This is also directly related to technology usage [4], suggesting a third hypothesis: social intelligence will increase technology adoption and usage. Companies and designers hope that the user will become attached to a product and brand. However, if a system with social intelligence is perceived to be trustworthy, there is the additional potential that a relationship will form between the individual and the interactive system [8]. This is not necessarily an ethical problem, but if it is possible, social intelligence in design could be used to take advantage of the user in an unethical way. For example, deceit and Machiavellianism are closely connected with social intelligence. When a system is perceived to have social intelligence, then an individual may grow to trust it [7], [27]. The potential for the system to be used for Machiavellian purposes then becomes real.

In the UCD of interactive systems, one may decide to conduct a field study in which the system is placed in the user's home. A user may become attached to the interactive system; this could grow into a relationship as a result of the trust between the user and the system [8]. This may have a negative impact on the user when the system is removed. In another example, individuals who find it difficult to establish friendships with other humans, due to an introverted personality, may find creating a relationship with technology easier, due to the familiar and comfortable home environment in which interaction takes place. In which case, it is important for social intelligence to be maintained. These implications of socially intelligent interactive systems must be considered carefully.

3.5 Challenge Five: Establishing & maintaining social intelligence

The assumption that social intelligence is a desirable and beneficial for user-system interaction will result in the design of socially intelligent systems. The *media equation* states that when social characteristics are perceived in media, users respond socially [28]. This is contrary to existing technology, when the user does not perceive social intelligence the user is less likely to respond in a social manner. If the vision of the future (e.g., [1]) is achieved and technology evolves to have perceptive and reasoning capabilities, the user may expect it to respond in a social manner. If everyone expects socially intelligent products it may become so normal that users become not conscious of it, in the same way that people expect courteous social behaviour from others. It is only when someone is not courteous that we notice a lack of social intelligence. We could call this a theory of expectance and apply it to interactive systems: unless one expects a product to be social, one will not be frustrated when it is not. The challenge then is to identify when social behaviour in interactive systems is beneficial and should be perceived, in which case it will become to be expected. One could approach this by focusing on social characteristics that annoy. The social behaviours that could be offensive will then be identified. For example, if an individual only notices a lack of social intelligence or an individual being rude or non-courteous, a threshold could be established for when social behaviour becomes non-social behaviour. This approach would not identify behaviour that will really augment interaction however. The absence of non-social behaviour will perhaps not have as pronounced an effect as a product that is very social.

Maintaining the perception of social intelligence is not simple however. If a system is placed in the home for a considerable amount of time, social characteristics will need to evolve, due to the importance of social memory on social intelligence [33]. People expect other individuals to remember previous interactions. Therefore, if a system does not evolve, it will only be perceived as social intelligent for a particular amount of time. The user's perceived social intelligence toward such a system will decline when a system cannot remember previous interactions. There are other factors that will influence the perceived level of social intelligence, including social faux-pas. The challenge, therefore, is to ensure that socially intelligent interactive systems maintain perceived social intelligence.

4 DISCUSSION & CONCLUSION

This paper has briefly outlined the conceptual background of social intelligence, and five challenges of applying social intelligence to the design of interactive systems. It has been reported (e.g. ([7], [22], [23], [24], [27] and [28]) that an interactive system with social attributes have a variety of effects on the user-system interaction, making them: more likable, competent, cooperative, attractive, credible, informative, knowledgeable, will improve successful interaction and greater trust. Benefits of these include trust, which is as an indicator of how accurately the user understands the system [19], and is directly related to technology usage [4]. These benefits suggest that systems with perceived social intelligence will ensure that system actions are intuitively understood by the user. This is essential considering the anticipated paradigmatic shift from existing user-system interaction [2], in visions of the future [1]. Nevertheless, the challenges identified reiterate the complexity surrounding social intelligence in design.

The five challenges imply that socially intelligent systems must evolve to be continually perceived as such. Given the influence of indeterminate individual and environmental factors, and culture, on social behaviour, systems will also have to adapt within interactions. To develop such systems, empirical studies must be conducted over a period of time to learn. The perceived social intelligence of systems will have to be evaluated over this period. It may also be necessary for systems to evaluate perceived social intelligence in situ, to ensure that social behaviour is appropriate. Research in the field of affective computing is increasingly developing ways to measure some of the more indeterminate individual characteristics. This will support future socially intelligent systems. In addition, the growth of the SID research field will also support the understanding of how context and embodiment influence user perception of socially intelligent systems, and the effect of social attributes on user-system interaction.

The goal of the SIFT project is to support the UCD of socially intelligent interactive systems. To achieve this, a model of social intelligence has been established. This will support the design of socially intelligent products and a psychometric instrument of perceived social intelligence. Given that [10] showed that perceived social intelligence in robots may only be successful in cases tested for system development, the model of social intelligence must be first contextualised. It will not be efficacious to develop a psychometric instrument to evaluate social intelligence for a number of different contexts and embodiments. It is proposed, therefore, that a modular psychometric instrument will be developed. It is hoped that the SID community will utilise such a resource to create a bank of psychometric tools for evaluating the perception of social intelligence in interactive systems.

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