Effects of gesture-based avatar-mediated communication on brainstorming and negotiation tasks among younger users

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ABSTRACT

This paper reports on a study which investigated the effects of gesture-based avatar-mediated communication on younger users (12–13 years old), in comparison to video-mediated communication. Specifically, we looked at how these technologies were used by school pupils to brainstorm and negotiate ideas in a bullying context. 64 school pupils were divided into two conditions (Skype and AvatarKinect) and were instructed to carry out two tasks (a brainstorming and a negotiation task). Objective task performance, perceived satisfaction and perceived partner's characteristics were compared. We found no difference in term of perceived satisfaction. AvatarKinect users reported more positive changes in perceptions toward their partner. The results on task performance were ambivalent; Skype users seemed to generate more ideas, whilst AvatarKinect produced better quality ideas. In summary, gesture-based avatar technology appears to be a useful modality to help resolve bullying in schools.

1. Introduction

The potential of technology to connect people and mediate people's interaction via computer interface is an ongoing concern of computer-mediated communication (CMC) studies. Traditionally, CMC facilitates interaction mainly through the medium of text and audio (Olaniran, 2002). With the advances in technology, video-based and 3D virtual environments are getting increasingly common (McIntyre & Feiner, 1996). 3D virtual environments are particularly interesting as social interactions is usually mediated by an avatar, a computer generated visual representation of the user. Both video and avatar-based CMC attempts to overcome a fundamental issue of traditional text or audio-based CMC – the lack of social cues (Garrison, Anderson, & Archer, 2000; Lea & Spears, 1992; Vrasidas & McIsaac, 2000). Recently, we have witnessed the emergence of new CMC technologies incorporating natural user interaction approaches such as gesture-based interfaces and facial recognition into avatar technology.

While the benefits and drawbacks of text and voice-mediated communication are fairly well explored (see Bordia, 1997), the communication potential of newer interaction modalities such as real time video, avatar-augmented and gesture-based interfaces are less well understood due to their fairly recent: (a) emergence (avatar and gesture interfaces), and (b) widespread adoption (real time video).

Therefore, the aim of the study is to find out how two different technological modalities, i.e. video-based and gesture-based avatar-mediated communication can facilitate brainstorming and negotiation tasks in the context of bullying in school. The specific objectives of the study are:

(a) to study gesture-based avatar-mediated communication in comparison to video-mediated communication;
(b) to provide some indications on how effective gesture-based avatar technologies are in the context of bullying among young people;
(c) to obtain some indications of design factors which are important for both types of communication.

2. Literature review

Most studies of CMC are of comparative nature focusing on the differences, advantages and disadvantages of CMC modalities as opposed to face-to-face (FtF) communication. Various theories, such as theory of social presence (Short, Williams, & Christie, 1976) and media richness theory (Daft & Lengel, 1986) provide important conceptual frameworks with which to analyse characteristics of each CMC modality in respect of their sociability potential, task completion and ability to transfer information. From the media richness theory point of view, text-based CMC (e.g. email, asynchronous messaging) is perceived as being less "rich", lacking in contextual and paralinguistic cues (Garrison et al., 2000; Lea & Spears, 1992; Olaniran, 2002; Sproull & Kiesler, 1986; Vrasidas

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& McIsaac, 2000), immediate feedback (An & Frick, 2006) as well as being poor in conveying the nuances and complexities of social and cultural dimensions of communication (Herring, 1996; Mitra, 2002; O'Dowd, 2004; Olaniran, Rodriguez, & Williams, 2010; Whittaker & O'Connail, 1997). Social presence, likewise, impacts online interaction; the leaner the medium, it is claimed, the less friendly and personal communication (Rice & Love, 1987).

Bordia (1997) analysed 18 experimental studies comparing FtF with different modalities of CMC. The comparison looked at differences in-group performance including idea generation, member participation, task completion and group dynamics. He concluded that CMC was generally more effective for idea generation tasks and completion of time-limited tasks. Individual member performance was also better in CMC, with evidence showing more equal participation due to the lower social pressure compared with FtF. However, CMC was less effective in understanding both the partner and the task involved while groups working with CMC displayed uninhibited behaviour resulting from an induced state of de-individuation (Bordia, 1997). Kiesler, Siegel, and McGuire (1984) explored the effect of text-based CMC on group interaction and decisions. Their findings indicate that CMC had noticeable effect on participation, interpersonal behaviour, decision making and efficiency. Compared with FtF communication, text-based CMC offers higher levels of self-disclosure due to the lack of auditory and non-verbal cues (Schouten, Valkenburg, & Peter, 2009), however it is less effective in building trust (Bos, Olson, Gergle, Olson, & Wright, 2002). As Rice, Hiltz, and Spencer (2005) point out 'a medium may not only be "too lean" for particular tasks, but also "too rich" for others'.

As we move from text-based CMC to synchronous audio and video-mediated communication, different considerations arise. Halliday (1986) points out that the two modalities "impose different grid on experience" with audio and video adding additional "richer" layers of interaction. Although both audio and video interactions carry more social cues than text (Gunawardena & Zittle, 1997; Hackman & Walker, 1990; McIsaac & Gunawardena, 1996), they are nevertheless both "dynamic and transitory", lacking fixed static record of interaction which is provided by text-based communication. Ramsay, Barabesi, and Preece (1996) found that users were keen to use different forms of media coupling in informal communication rather than relying on time-based media alone.

Early studies into video-mediated communication (VMC) found no substantial benefits of using VMC compared with audio (Ochsman & Chapanis, 1974), although audio-mediated communication was found to improve task performance and perceived affordances (Ochsman & Chapanis, 1974) as well as learners' affective side and output (Yamada, 2009). Stephenson, Ayling, and Rutter (1976) compared the content of dyadic interaction in voice only and FtF. Voice interaction was more task-oriented and impersonal compared with FtF. Chapanis (1975) found that the voice-mediated communication by itself was inferior to FtF lacking in richness and variety while the average amount of time to perform a task was only a little bit longer than FtF.

A study by O'Malley et al. (1996a) found that VMC was more effective compared with voice-mediated communication in task performance as subjects could see each other's faces, thus needed to say less. Boyle, Anderson, and Newlands (1994) also found that visibility of conversational partner makes the information transfer and the turn taking more effective in a conversational problem solving task. Other research findings did not support these conclusions. Morley and Stephenson (1970) compared negotiation tasks across three modalities: FtF, video/audio and speech only. They found that audio-mediated communication was much more task-oriented, while participants in video and FtF interactions were more likely to compromise due to the presence of interpersonal information. Although in some cases VMC can be used as a substi-

tute for informal FtF interactions, in itself it cannot replicate the richness and diversity of FtF (Wilbur & Ing, 1996).

2.1. Avatar-mediated communication

One of the more recent technologies in CMC is avatar-based. Avatar is a computer generated graphic image which represents users in online interactions. Since its inception, avatar technologies have become increasingly popular, and this has spurred renewed research interests in CMC surrounding this technology. Some research themes include the effect of avatar appearance (Bailenson & Yee, 2007; Garau et al., 2003; Nowak & Rauh, 2006), communicative realism (Bailenson, Blascovich, Beall, & Loomis, 2003; Von der Pütten, Krämer, Gratch, & Kang, 2010), emotional engagement (Taylor, 2011) and transmission of social cues (Walther, 1996). Garau et al. (2003) investigated the impact of avatar appearance on the perceived quality of communication in a virtual world. The study found that the higher the realistic quality of the avatar appearance, the better perceived quality of communication. A study by Bente, Rüggenberg, Krämer, and Eschenburg (2008) investigated the influence of avatars on social presence, trust between participants, non-verbal behaviour and perceived quality of interaction. They found that there were no substantial differences between video and avatar modalities in terms of observable behaviour and participants' experience.

In a study comparing text, audio, video and avatar communication found that video and avatar did not differ in relation to social presence, trust and user satisfaction when compared with voice. The differences between video and avatar mediated communication have been summarised by Bente and Krämer (2011) as follows: (a) avatars have freedom of movement in a shared space which might also have an impact on virtual objects, (b) users can remain anonymous without disclosing personal information such as appearance or gender, and (c) behavioural data rather than pixels guide the transmission of non-verbal cues. Overall, it seems that avatar-based communication studies offer a "disintegrated picture of the research field" (Bente & Krämer, 2011). This is largely due to the fact that existing avatar technologies are very different and therefore difficult to compare.

2.2. Study of younger users and CMC

Research into the adoption of CMC by young people (e.g. adolescents) focuses primarily on text-based internet communication (instant messaging and chat) which is used to chat about ordinary topics, share intimate details about friends, gossip, as well as maintain relationships with circles of offline friends (Gross, 2004).

A study by Valkenburg and Peter (2007) investigated Dutch online communication of teenagers between the age of 10 and 17 years. They found that there was a positive relationship between online communication and time adolescents spent online and the quality of their friendship which resulted in adolescents' improved sense of well-being. Self-disclosure online was studied by Schouten et al. (2009) who found that adolescents were more likely to self-disclose online because the perception of fewer non-verbal cues led to them feeling more disinhibited. They also discovered that participants who were socially anxious thought that the Internet offered more value for intimate disclosure than those who did not have a socially anxious nature (Valkenburg & Peter, 2007). Similarly, a study into Israeli adolescents behaviour online conducted by Mesch (2003) found that more socially isolated adolescents are more likely to be frequent Internet users. In general, research into the use of avatar technology has so far been focused predominantly on adult users.