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Effects of Team-Based Computer Interaction: The Media Equation and Game Design Considerations

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Abstract. The current paper applies media equation research to video game design. The paper presents a review of the existing media equation research, describes a specific study conducted by the authors, discusses how the findings of the study can be used to inform future game design, and explores how other media equation findings might be incorporated into game design. The specific study, discussed in detail in the paper, explores the notion of team formation between humans and computer team-mates. The results show that while highly experienced users will accept a computer as a team-mate, they tend to react more negatively towards the computer than to human teammates (a 'Black Sheep' Effect). **Keywords:** Media Equation, Team Formation, Groups, Game Design

Introduction

The media equation is based on the idea that people respond socially to computers. In its simplest form the media equation can be stated as 'media equals real life': more broadly it is the concept that people's interactions with televisions, computers and new media are fundamentally social and natural [1]. In media equation studies, the social dynamics surrounding human-human interactions are shown to exist in human-computer interactions. The studies conducted supporting the media equation all follow a similar research process. The process is as follows: (a) pick a social science finding (usually within social psychology or sociology) which concerns behaviour or attitudes towards humans, (b) substitute 'computer' for 'human' in the statement of the theory e.g., 'people like people that flatter them' becomes 'people like computers that flatter them' [2], (c) replicate the methodology of the social science study but replace one or more humans with computers, (d) determine if the social rule still applies [3].

A myriad of different media equation effects are described in the literature. The vast majority of this research can be considered to fall into four categories, reflecting the kinds of psychological or sociological effects that are being explored. Human research in the areas of traits, social rules and norms, identity, and communication has been shown to be applicable to human-computer interactions. Media equation research focusing on human traits includes studies on gain-loss theory [4], social facilitation [5], social presence [6] and principles of attraction [6-8]. For example, research has shown that people tend to prefer computers that are similar to themselves [8, 9] which parallels the tendency to prefer other people who are similar to oneself (the similarity attraction hypothesis) [10-12]. The media equation research concentrating on social rules and norms has explored reciprocity [13-16], flattery [2, 17], politeness [18], assignment of roles [19] and praise and criticism [20]. For example, there is evidence that people perceive a computer who criticises others to be smarter than a computer that praises others, which is the same process that tends to occur between people [20]. Media equation research focusing on identity incorporates studies on group formation and affiliation [21, 22], self-serving bias [23], and stereotyping [24]. For example, research has shown that people (both male and female) will apply gender-based stereotypes to a computer as a function of whether the computer communicates using a male or female voice [24]. The media equation research directed towards issues of communication has included studies exploring party host behaviour [25], balance theory [26] and emotion theory and active listening [27]. The latter researchers, for example, found that for people experiencing negative affect (e.g., frustration), interacting with a computer that provided sincere non-judgmental feedback led to a moderation of the negative feelings experienced (as often happens when people talk to other people who offer sincere non-judgmental feedback).

General Applications of the Media Equation

Recently, the media equation has been applied to the design and implementation of software programs, interfaces and electronic devices. Both the general theory, that people tend to treat computers as though they are real people and places, and specific media equation findings have proven useful to designers. Cooper [28] applied the media equation theory (particularly findings regarding politeness; see [18]) when creating a series of principles for programmers to use when designing software. Diederiks [29] analyzed 'L-icons' (virtual personal friends that make viewing recommendations for a television system) and 'Bello' (a virtual pet dog that facilitates voice control for a television set) and found evidence that animated characters deploying social behaviour and social rules make it easier to interact with consumer electronic products. Friedman, Kahn and Hagman [30] found that as a result of the social cues they provide, AIBO robots (small robotic dogs produced by SONY) provide their owners with social companionship and emotional satisfaction. Based on the media equation literature, Johnson [31] designed and implemented guidebots (or virtual tutors) based on the behaviour of actual human teachers. The results of this work are being used to create a social intelligence model to be incorporated into a guidebot-enhanced interface, which will be able to assess when pedagogical interventions are appropriate. These examples represent a sample taken from the population of published applications of the media equation, and as such do not represent the full scope of applications drawing on media equation research that are currently in existence.

Experience as a Moderator of the Media Equation

Recent research conducted by Johnson, Gardner and Wiles [17] found evidence suggesting a link between degree of experience with computers and propensity to show a media equation response to computers. An informal survey of computer users of varying levels of experience revealed that most people expect that users with high levels of experience with computers are *less* likely to exhibit the tendency to treat computers as though they were real people. This belief is based on the argument that more experienced users, having spent more time using computers, are more likely to view the computer as a tool. They are more likely to be aware of the computer's true status -- that of a machine. However, the research conducted does not support this argument, Johnson et al. found that more experienced participants were *more* likely to exhibit a media equation response.

Specifically, participants of high experience, but not low experience, displayed a media equation pattern of results, reacting to flattery from a computer in a manner congruent with peoples' reactions to flattery from other humans. High experience participants tended to believe that the computer spoke the truth, experienced more positive affect as a result of flattery, and judged the computer's performance more favorably (for a detailed discussion of these findings, their relation to the media equation and it's theorized relationship to mindlessness the reader is directed to the original paper [17])

Group Identity and the Media Equation

One of the strongest findings in intergroup behaviour research is the minimal group effect [32]. The minimal group paradigm is an experimental methodology developed by Tajfel and colleagues in order to explore the minimal conditions required for intergroup behaviour (including team formation) [33]. In Tajfel and colleague's original study, participants were invited to take part in a study on decision making and assigned to one of two groups on the basis of their reported preference for paintings by either the artist Klandinski or Klee. Participants were then given the opportunity to allocate money to pairs of fellow participants identified only by group membership. The results indicated that participants tended to strongly favor their own group [33]. The striking feature of this and subsequent minimal group paradigm (MGP) studies is that team affiliation effects resulted even though the categorisation was on the basis of a largely arbitrary criterion, the groups created had no history or future, and self-interest was not a motivating factor for participants [32].

More recently, MGP studies have shown categorisation and associated affiliation effects on the basis of coin toss allocations to groups K or W [34], painting preferences [35, 36], line length estimation (overestimators and underestimators) [37], random categorisation to groups X and Y [38], figural versus grounded perceptual style [39], shape dependency and independency [40], and concave and convex attention styles [41].

The Current Study

The current study was designed to test whether minimal categorisation could be used to create a sense of team affiliation between human participants and computers. It was hypothesized that participants would show group affiliation effects as a result of being placed on a team with a computer (H1). Moreover, it was hypothesized (based on previous research) that this effect would be stronger for participants with a greater degree of experience with computers (H2).

Method

Procedure

Sixty University of Queensland students participated in the study (40 females and 20 males). Participants ranged in age 17 to 35, with an average age of 19.8 years.
Participants were initially told that the study dealt with decision making with computers. Participants were informed that the computers they were working on had been trained to use neural networks to complete two different tasks: a text rating task (TRT), and a desert survival task (DST).

For the TRT, participants read a body of text and rated the extent to which six words (descriptive, emotive, intriguing, factual, stimulating, entertaining) accurately described the text. Then the computer presented its own ratings. Ostensibly, the computer ratings were based on the neural network it employed; in fact, the computer ratings were systematically different to the participants' ratings. After viewing the computer's ratings, participants were allowed to alter their original ratings.

For the DST, participants were asked to imagine they were stranded in the desert and to rank 12 items according to their importance for survival. When participants had completed their ranking, the computer gave a suggested ranking and listed a rationale for its suggestions. Ostensibly, the computer used a neural network to rank the items; in fact, the computer's ranking was systematically different from the participant's. After viewing the computers' suggested ranking and rationale, participants were allowed to alter their own rankings.

The experiment had three conditions: control (N = 25), human team (N = 19), and human-computer team (N = 17). In the control condition, participants were told they would be working on their own during the experiment, and the experimental materials and procedures were designed to promote the notion of individual work. In the human team condition, participants told they would be working as part of one of two teams, and materials and procedures were set up to promote the distinction between the people in the teams. In the human-computer team condition, participants were also told they would be working as part of one of two teams, but materials and procedures were set up to include the computers as part of each team.

Measures

After all interaction with the computer was complete, participants completed the written questionnaire. Participants' degree of experience with computers was assessed, and they were classified as having low or high experience. To assess mood, the questionnaire included the Positive and Negative Affect Scale; 20 mood descriptors designed to assess mood states [42]. Participants' attitudes towards the TRT and the DST were assessed; participants also rated the quality of the information provided by the computer. To assess their openness to influence from the computer, participants rated seven items drawn from prior research [21, 22]. For each task, participants were asked to assess the extent to which their ratings/rankings had changed: a *subjective* measure of the degree to which respondents were influenced by the computer. *Objective* measures of the extent to which participants were influenced by the computer were also recorded by summing numerical changes in participants' ratings and rankings. Demographic data were also collected.

Exploratory factor analyses were conducted to identify variables to be combined into scales. Analysis of the PANAS items showed a two-factor solution, with the 10 positive mood descriptors loading on one factor (Positive mood; Cronbach's □ = .78) and the 10 negative mood descriptors loading on another factor (Negative mood; □ = .74). The three items assessing ratings of the TRT loaded on a single factor (TRT rating; □ = .91). Similarly, the three items assessing ratings of the DST loaded on a single factor (DST rating; □ = .87). The three items rating the quality of the computer information loaded on a single factor (Information quality; □ = .85), as did the seven items assessing respondent's openness to influence (Openness to influence; □ = .91).

Results

A series of one-way ANOVAs were conducted on the dependent measures, with the experimental manipulation (control, human team and human-computer team) as the independent variable. Results from these initial analyses were non-significant. Prior findings suggest that media equation effects are more apparent amongst people with more extensive experience with computers [17], so the sample was split into respondents with low and high experience with computers. Subsequent one-way ANOVAs were conducted separately for these two groups. The ANOVAs conducted on the low-experience respondents ($N = 32$) showed no significant effect of experimental manipulation for any of the dependent measures.

The ANOVAs conducted on the high-experience respondents ($N = 28$) showed significant effects across the experimental manipulation for several measures. There were significant differences across conditions for the ratings of both the TRT ($F(2,25) = 3.87$, $p < .05$) and the DST ($F(2,25) = 3.90$, $p < .05$). Examination of the mean scores indicated that high experience participants in the human team and human-computer team conditions rated both tasks more positively than their counterparts in the control condition (see Table 1). No such pattern existed for low experience participants. This finding suggests that for high experience (but not low experience) respondents, simply being placed in a team was sufficient to promote more positive attitudes to the tasks than working alone (in the control condition).

Table 1. Mean Scores for Dependent Measures Across Conditions

Measure	Low Experience			High Experience		
	Control	Human	Human-Comp	Control	Human	Human-Comp
TRT Rating	4.0	3.3	3.2	2.5	4.5	4.4
DST Rating	5.7	4.6	5.1	4.4	5.7	6.1
TRT Subjective Infl.	2.1	1.0	1.6	1.0	1.7	0.6
Information Quality	5.5	5.6	6.0	6.1	5.8	4.6
Openness to Infl.	5.8	5.2	5.2	6.1	6.0	4.5
TRT Objective Infl.	118.6	122.1	115.3	121.1	107.2	143.6
DST Objective Infl.	27.0	28.2	25.7	20.8	13.7	32.7

For high experience respondents' subjective measures of how much they were influenced by the computer, there were significant differences across conditions for the text rating task ($F(2,25) = 4.10$, $p < .05$), but not the desert survival task. Mean scores for the TRT suggested that respondents reported less alteration of their responses in the human-computer team condition than in the control and human team conditions (see Table 1). High experience respondents, who were working in a team with other people and a computer, subjectively rated themselves as being less influenced by the computer in the TRT than high experience participants in either the control condition or the human team condition.

High experience respondents showed significant differences across conditions for both their ratings of the quality of information provided by the computer ($F(2,25) = 5.01$, $p < .05$), and their openness to influence from the computer ($F(2,25) = 3.77$, $p < .05$). Mean scores for these measures indicated that high-experience respondents in the human-computer team condition rated the quality of information from the computer lower, and reported lower openness to influence from the computer than those in the control and human team conditions (see Table 1). When high experience participants were placed in a team with a computer as well as other humans, they were less positive about the quality of information provided by the computer, and reported being less open to being influenced by the computer.

Amongst high experience respondents, there were significant differences across conditions for the objective measures of the computer's influence for both the text rating task ($F(2,25) = 6.07$, $p < .01$) and the desert survival task ($F(2,25) = 4.00$, $p < .05$). Mean scores for these measures indicated that high-experience respondents in the human-computer team condition had ratings/rankings that were *further* from the computer's suggestions in both the TRT and the DST than their counterparts in the control and human team conditions (see Table 1). In both tasks, high experience participants in a team with a computer were *less* influenced by the computer, than were high experienced participants in the human team and control conditions.

Discussion

Consistent with previous media equation research [17], a media equation pattern of behaviour was exhibited by participants who had high experience with computers but not by participants with low experience with computers (supporting H2). An unexpected but consistent pattern of results arose for high experience participants across the human team and human-computer team conditions. Broadly, high experience participants in the human-computer team condition rated the quality of information from the computer lower, felt they were less open to influence from the computer, perceived their own responses to the text rating task to be less influenced by the computer's ratings, and were actually less influenced by the computer's response in both the text rating and desert survival tasks than were high experience participants in the human team condition (contrary to H1). This finding is in contrast to the findings of Nass and colleagues [21, 22] in which participants (on a team with a computer teammate) perceived the computer as having more influence, rated the quality of information from the computer more highly, and conformed more to the computers recommendations when the computer was made a part of the team.

The contrary pattern of results obtained in the current study is intriguing, as it is not possible to conclude that the identity manipulation did not work. Firstly, team affiliation effects are present for high experience participants in terms of rating of the tasks. Secondly, those in the human-computer team condition did not show the same attitudes and behaviour as those in the human team condition. Those who had a computer teammate as well as human teammates generally reacted negatively towards the computer in comparison to those who were part of a team without the computer as a teammate. This finding suggests that there is something unique about being on a team that includes a computer, which evokes a negative reaction towards that computer.

This result raises the question of why these high experience people would be inclined to disregard or undervalue the computer's recommendations. Our initial consideration of the social identity literature led us to hypothesise the opposite pattern of results. We expected high experience participants to be more likely to treat the computer as a team member and thus, expected them to be more likely to be influenced by the computer's ratings and rankings in the two tasks, when the computer was made part of the team. The pattern of results obtained contradicted these expectations; high experience participants working with the computer as a team member were less influenced by the computer than either low experience participants or participants in which the computer was not a team member.

However, further exploration of the social identity literature leads to explanations of these results that are in line with the media equation explanation of people's reactions to computers. Research has been conducted identifying a phenomenon known as the 'Black Sheep Effect', whereby group members may reject another group member based on that group member's deviation from the group prototype [43-50]. These studies highlight unfavourable evaluations and derogation of ingroup members as a form of ingroup bias that marginalises members who threaten positive ingroup identity. If the current findings are considered in light of the 'black sheep effect', then they can be interpreted as a clear example of media equation behaviour. Specifically, high experience participants placed on a team with the computer (but not low experience participants) treat the computer like a person to the extent that they perceive the computer as a member of the ingroup, albeit a member of the group that does not contribute positively to their group identification. As a result, high experience participants derogate this less positively perceived group member (the computer) by placing less value on its recommended ratings and rankings and generally perceiving its contribution to be of less value. This derogation of the computer and the information it provides does not occur among high experience participants unless the computer is implied to be a member of the team. Low experience participants, on the other hand, do not exhibit a media equation pattern of results; even when it is implied that the computer is a team member, the computer is not perceived as a member of the group, and thus no negative reaction towards the computer as a group member occurs. This explanation is strengthened by the fact that the results extend beyond subjective ratings and into objective behaviour. The pattern of results was consistent for subjective ratings of the quality of information provided by the computer, subjective ratings of the degree to which participants felt they were open to influence from the computer, subjective ratings of the degree to which participants thought they were influenced by the computer in one of the tasks, and objective measures of the degree to which participants actually were influenced by the computer in both tasks.

It would seem that while high experience computer users tend to treat computers like real people to the extent that they will accept the categorisation of the computer as a fellow group member, the effect is not strong enough for them to perceive the computer as a positive addition to the group. Rather, high experience users seem to be prepared to accept the computer as a teammate, but presumably because of deviations from the assumed group prototype, the computer is reacted to negatively and its input is marginalized or disregarded. According to the black sheep theory of group formation, this derogation of the marginal ingroup member (in this case the computer) serves to strengthen and protect the existing team identity.

An alternative explanation for this pattern of results would be that participants found the concept of having the computer as a teammate ridiculous. In response to being forced into an absurd situation, participants became belligerent and deliberately changed their responses to be contrary to the recommendations made by the computer. However, this explanation cannot account for the fact that only high experience participants rated the information provided by the computer as less useful, perceived themselves as less influenced by the computer, perceived themselves as less similar to the computer, and changed their responses away from the recommendations made by the computer. Nor can it account for the fact that high experience participants reported enjoying the task more when they worked as part of a team regardless of whether the computer was part of the team.

Application of Current Findings to Games

Within the arena of video games, the most obvious applicable finding is that people tend to enjoy a task more when placed within a team environment (whether or not a computer is a member of the team). This suggests that enjoyment of tasks in single-player games can be improved by helping the player feel like they are part of a team. This technique (increasing enjoyment of tasks by creating a sense of being on a team) is already utilised in many games (for example, Jak 3 or Half Life 2, in which the player is led to believe they are acting in concert with, or for the benefit of, other non-player characters (NPCs)).

The aforementioned application relates specifically to the player's attitude towards the *tasks* being undertaken within a game. The current findings are also relevant to the player's attitude towards the other *characters* within the game. Specifically, consideration should be given to games in which the player controls a character in a team setting and the computer controls NPCs on the team (role playing games, real-time strategy games and first-person shooters). The current research suggests that players (at least those of high experience) will accept computer players as part of the team, but may react negatively towards them or value them less than other human members of the team (as they deviate from the group prototype in the same way as the computer team-members in the current study – they are not human). At first glance, it might appear that this is something to be avoided by game developers on the basis that a negative reaction on the part of the player towards an NPC is a bad thing. However, the research on the black sheep effect shows that derogation of a marginal in-group member (in this case a NPC) serves to strengthen and protect the existing team identity. Thus, it is quite possible that NPCs on teams in videogames can and do play a "scapegoat" role, becoming a target towards which the human members of the team can release their frustration, direct blame and generally release negative emotions. Ultimately, NPCs placed in such a role would strengthen the sense of identity amongst the human members of the team.

Application of General Media Equation Findings to Games

From the myriad of media equation findings there are a wide variety that can be applied to the development of video games. What follows is by no means an exhaustive list, rather the aim is to provide a few examples of how media equation research can be applied to video games and thereby highlight the fact that the media equation is a ready source of design principles and techniques that can be applied in video game development.

One of the strongest and most consistent findings in psychological research is that perceptions of similarity increase attraction between people [51]. Nass and colleagues [4, 8, 9, 52] were able to show that computers exhibiting similar levels of extroversion, introversion, submissiveness or dominance (displayed via the style of text based communication or tone of voice) as their human users were perceived far more positively than computers which were not doing so. To this end, it seems safe to assume that videogames that contain NPCs with personalities similar to those of the player will be more positively perceived. For example, in an action adventure game, a short questionnaire or observation of the player's choices in the early stages of the game could allow for the facilitation of the player interacting with NPCs who exhibit similar personality traits to the player; this would facilitate greater positivity on the part of the player towards the NPCs.

Research has also shown that the gain/loss theory of interpersonal attractiveness (which suggests that individuals will be more attracted to others who initially dislike them and then come to like them, than to others who consistently like them) is applicable to interactions between people and computers [4]. This could be a useful technique for games in which players continually interact with one particular NPC across the course of a game (for example a game in which a particular NPC is a 'sidekick' or a tutor/helper). Such characters, if they initially treated the player negatively and became more positive or friendly over time, should become far more well-liked by the player than an NPC that is consistently positive.

In the context of the social norm that 'we should treat others the way they treat us', there is a great deal of research showing that if people receive a favour from others they feel obligated to reciprocate [32]. A series of media equation studies [14-16] demonstrated that people will feel indebted to a computer that provides a benefit, and subsequently reciprocate to that computer. The notion of the player receiving 'favours' or 'benefits' from a game or NPCs within a game is quite common ('power-ups', weapon upgrades, bonus levels etc.). It may be that these benefits can be leveraged by developers to encourage players to meet other objectives, such as the completion of specific tasks requested by NPCs. This technique may also be useful outside the game environment, for example; providing players with a bonus level or weapon in return for the completion of an online survey focussed on future game development.

One of the areas of media equation research most obviously applicable to video games is the research conducted on flattery. Just as people tend to react positively to flattery from others, researchers [2, 17] have shown that when flattered by computers, people tend to believe that the computer spoke the truth, experience more positive affect as a result of the flattery, and judge the computer's performance more favourably. This is one design technique identified in media equation research that is being applied in existing video games. Many first-person shooters (such as Quake, Unreal Tournament and Halo 2) use a voice-over or on-screen text to flatter players when they are performing well. This technique may well prove effective in other video games where little or no feedback is provided to the player while playing the game.

It is hoped that the suggested applications of the current study in combination with the aforementioned general examples of design principles derived from media equation research will inspire academics and game developers to further explore the potential synergies between the media equation and video game design.

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