OLD BRAIN AND NEW MEDIA: EXTENDING THE MEDIA EQUATION THROUGH THEORY AND RESEARCH

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INTRODUCTION

People's interaction with new media is provoking great interest, both academic a practical. Educators and cognitive scientists are seeking to better understand th potentials of new media. The traditional approach towards new media sees it as tool—a tool with great affordances and potential, but a tool nonetheless, much li a hammer or a automobile. However recent research indicates that when peopl work with computer-based media they respond to it not as a tool but rather as a intentional social actor (Reeves & Nass, 1996). In brief, people behave with me just as they would with people. Individuals' interactions with computers, televisio new media are fundamentally social and natural just like interactions in real life. For instance, they are polite to machines; they feel betrayed and angered by machines, are flattered by machines, treat machines as teammates, and so on. This response is instinctual and does not go away with expertise. Children show (Turkle, 1984) and so do expert computer programmers (Reeves & Nass, 1996; Winograd, 1976).

This paper is in four parts. First we present an overview of the media equation a a summary of the research conducted by the Social Responses to Communications Technologies research group. The second section describes three experiments conducted by our group that extend the existing research on social responses to interactive technologies. Given that the media equation exis it is unclear as to why it happens. The third section offers a theoretical explanati for why the media equation occurs. The SCRT group has hinted at an evolution explanation though the evidence for this is never spelt out in any detail. We offe detailed argument based on current research in cognitive science, development psychology and evolutionary psychology and by drawing a parallel to the cogniti processes the underlie people's perception of pictures. Finally, we discuss what impact these findings have for research and design in the area of educational technology.

INTRODUCTION TO THE MEDIA EQUATION

The idea that "mediated life" is equivalent to "real life," at least as far as people' cognitive and behavioral responses are concerned, is the central claim of what been termed the media equation. Reeves and Nass(1966), as a part of their So Responses to Communication Technologies (SCRT) research program have conducted a number of studies whose results seem to indicate that individuals respond to various forms of media in a manner social psychology has found customary to interactions with other people. In fact, the automatic and natural response to media is for one to treat it as if it were an actual social actor.

To begin with, Reeves and Nass demonstrate that many of the same characteristics of an interaction that effect our evaluations of people also influen our evaluations of media. For example, just as people receive more positive repl when they ask about their own performance than if an independent third party makes the inquiry, research participants were more polite in their evaluations of computer tutorial if the assessment was given on the same computer that presented the tutorial than if surveyed on another computer or with pencil and paper. In fact, utilizing different voices on the same computer was enough to illic this perception of otherness. If the same voice is used to give both the tutorial a the assessment, the evaluation is more positive than if the assessment is presented by a different voice on the same computer.

A computer that flatters its user will illicit more positive evaluations than one that doesn't. On the other hand, the computer that praises itself is less liked than the computer that is praised by another computer and its self-evaluation is perceive as less accurate. As with people, the critical computer is not well-liked, though it perceived as more intelligent.

Similar to our human interactions, it appears that we are quick to categorize our media participants and these categories serve to color both our impressions of them and their performance. Reeves and Nass_ findings suggest that computer users can perceive a computer as possessing personality. Computers utilizing either dominant or submissive text were identified as either dominant or submissive and participants matched with a computer of similar personality view it as more intelligent, knowledgeable, insightful competent, helpful and useful th those mismatched. In fact just as you value the judgment of the person you hav won over to your way of thinking more than the one who agreed with you all alo those who worked with a computer that switched from the opposite personality t the match the one of the user, were rated more competent than if the computer maintained the matched personality throughout.

Another fairly typical and promptly identified category is that of the in-group or out-group. Social psychology has demonstrated time and again that similarity is presumed of members of the same group or "team" and the elevation of attitude toward group members such a perceived affiliation produces even when the groups are newly created at random. This same membership and positive opini appears to also be extended to media technology. Participants in Reeves and Nass_ research who worked with a computer labeled as a "teammate" only by a shared color label, thought that the computer solved problems in a more similar fashion to themselves, believed the computer agreed more with them and thoug that the information the computer offered was more relevant, helpful, and insight than did participants who worked with a computer labeled with another color. In addition, they were more open to the computer_s suggestions and changed thei answers more to agree with their computer teammate than those not so "teame

Our affinity for categorization in mediated experience, as in "real life," also runs t risk of triggering cultural stereotypes. Both men and women, in Reeves and Nas research, were more influenced by praise from a computer with a male voice an when one computer praised the performance of another, participants believed th first computer had performed better when it was praised by a male voice. Also a computer with a female voice was believed to be a better teacher about information related to love and relationships while a male-voiced computer was deemed a better teacher about computers.

EXTENDING THE RESEARCH

Over the past year we have been involved in developing a research program th looks at theoretical and pragmatic aspects of the media equation. In this section we describe and present the results of three studies conducted by our group. Th first study looks at emotional responses to computers specifically at experiences unfairness, anger and spite. The second study investigates the manner in which the recall of information presented by a computer program is dependent on the perceived expertise of the program. Finally, the third study looks at the manner i which expert and novice computer users react to a software "agent" that behave in a socially appropriate manner.

Experiment 1. Emotional Responses to computers: Experiences in Unfairness a Spite

The research on ultimatum bargaining indicates that counter to theoretical predictions, positive offers are often rejected leaving both parties with lower economic outcomes (Pilluta & Murnighan, 1996). These instances are often explained in regards to a human's ability to evaluate fairness. Researchers, theorists, and economists have argued that fairness, related to the size of the of and other outside information, determines whether offers get rejected or accept

In a recent study, Pilluta & Murnighan (1996) argued that emotions, a variable n often addressed in the ultimatum bargaining literature, and specifically the emoti of anger, play a much larger role than originally thought. Their model proposes t "perceptions of unfair treatment and feelings of wounded pride and anger provid the basis for spiteful rejections and inefficient disagreements. Wounded pride refers to a personal, inwardly focused feeling when another's actions violate a person's sense of self-worth. Spite is the behavioral reaction that accompanies anger and which is designed to hurt the offending other...people believe that revenge has its own moral imperative."

The key question in this study was whether we could replicate the ultimatum bargaining research by replacing human-human interaction with human-comput interaction. This exercise serves two important functions. First, Nass and Reeve do provide modest evidence for the existence of emotional responses in the soc relationships with technology. This study would allow us to further that line of research by focusing solely on anger. Second, it seems that fairness (and detecting unfairness or cheating) is an instinct that is extremely strong in human (Cosmides & Tooby, 1989).

Subjects completed an initial survey and were then told:

> You have been assigned to the A group. In a moment, when you log-in to the computer, you will be connected with your partner. Your partner, who will either be a human or a computer, has been assigned to the B group. They have been given three different sums of money. They have been instructed to divide the sums and offer you a portion of the total. If you accept, you will receive the offer and they will receive the rest. If you reject, neither you or your partner will receive anything. You will complete these negotiations three separate times. After each negotiation, your connection will break and you will be asked to fill out a short questionnaire prior to reconnecting. As we can not pay everyone for all offers they accept, a lottery will be drawn at the end of the study. Any accepted offer will be put into a hopper. If you or your partner's name is drawn, you will both receive the amount of the accepted offer. If you have any questions, please ask. Otherwise, please log-in.

As they logged in, the computer assigned them to one of four experimental-respondent groups (see Table 1).

	Human	Computer
Partial Information	15	15
Complete Information	15	15

Table 1: Number of participants/group.

After logging in, they met their partner. Each respondent was assigned to "Chip" universal name for both human and computer. Chip greeted them with either "H Wassup? I'm Chip, and I'm a junior here at State" or "Hey! Wassup? I'm Chip, a

I'm a pentium computer here at State." After being greeted, they had the chance respond to Chip.

Next, they were presented with the first offer. Both groups were offered $5. This initial round was given to gather a baseline of scores of how people reacted to being given free money. After each of the three rounds, the respondents were asked to fill out a short survey asking them three questions:

> How do you feel about the offer?
> (Happy-Unhappy on a Lickert scale)
>
> What do you think about the offer? (Fair-Unfair on a Lickert scale)
>
> Please list any comments you have.

In round two, respondents were once again offered $5. However, following their decision and prior to filling out the survey, Chip told them that he actually had $5 to divide and offered them only $5 of that total amount.

The third and final offer was also for $5. The money amounts were kept consist as research provides evidence that variation in money offering is one of the maj variables in ultimatum bargaining—a variable not necessary to include for this study. However, the two groups were divided into four for the final round of negotiating. In ultimatum bargaining, it is often predicted that feelings of unfairn will precede wounded pride, anger, and eventually spite. Prior to making the fina decision, half of the computer group and half of the human group were given complete information (i.e. told that the amount being shared was $10). Meaning, unlike previous rounds, Chip informed these participants how much money he w splitting. The other two groups were once again only given partial information.

Sixty participants fully completed both the questionnaire and the accompanying surveys. Of those 60 participants, 53% were men, 47% were women, 86% were U.S. students and 14% were foreign (split between the Republic of China and India).

	Human Group		**Computer Group**	
	Accept Offer	Reject Offer	Accept Offer	Reject Offe
Trial 1	24	6	19	11
Trial 2	18	12	16	14
Trial 3 Partial	8	7	7	8
Trial 3 Comp.	14	1	12	3

Table 2: Acceptance and rejection offers/group.

Table 2 highlights the number of accepts and rejects between the four different groups. The data show that men were more happy to receive money on the first trial than were the women ($p<.02$). Students were happier ($p<.007$) and thought the offer was more fair (p<.003) in the groups that received the complete information. There was also a significant relationship between the group one wa assigned to and the response for trial #3 (p<.002). So far the data replicate what Pillutla and Murnighan found: (a) more complete information leads to people's assumptions of more fair deals and thus happier people; and (b) fairness plays important role in ultimatum bargaining. However, for the key question, does the presence or absence of the computer matter to the respondents behavior the answer is a clear No! There were no significant difference between the human-human groups and the human-computer groups.

Experiment 2. Perceived Language Expertise in Human-Computer Interaction

This study examines whether non-native speakers assign the role of language expert to computers, when the computer portrays qualities of "nativeness." A computer was identified as a language expert or native speaker computer (an Anglo-Saxon name and an English native speaker, female voice) and a second computer was identified as a non-language expert or non-native speaker compu (a Hispanic name and a fluent, faultless non-native speaker, female voice). Both computers delivered identical content in the form of a language tutorial, but the voices providing the instructions and names differed. Participants were thirty-tw adults, in intermediate and advanced English as a second language courses at Midwestern university. They were randomly assigned to each of the two conditio or computers. After completing the tutorial, participants filled out a post-task questionnaire that evaluated the credibility or expertise of the computers. It was hypothesized that non-native speakers would more positively evaluate the information delivered by the "native speaker" computer than the information delivered by the "non-native speaker".

In addition to this, results also showed a significant difference in the content post-test i.e. those that worked with the native speaker computer performed significantly better than those working with the non-native speaker computer wh recall the correct information presented in the language tutorial. However, there was no significant difference in the perception of language expertise, with a significant interaction between gender and expertise. Men rated the non native speaker computer as being less grammatical and friendly than women.

Source	n	M	SD	t.value	df
Expert	8	1.187	0.372	*2.81	11
Non-expert	8	1.875	0.582		

Table 3. Summary of T-test: Friendliness of software, *p< 0.5

Source	n	M	SD	t.value	df
Expert	8	1.500	0.463	*1.82	13
Non-expert	8	1.875	0.354		

Table 4. Summary of T-test: grammatical correctness of content, *p< 0.5

Source	n	M	SD	t.value	df
Expert	16	7.625	0.50	*1.83	30
Non-expert	16	7.06	1.12		

Table 5. Summary of T-test: recall of correct information, *p< 0.5

Experiment 3. Expertise and Value of Social Norms

The Office Assistant (provided with Microsoft Office 98) is a computer program developed on the basis of the research conducted by the SCRT group. This stu investigated how different levels of expertise in users determines their response the Office Assistant.

The variables included in this study were the presence of the Microsoft Office Assistant and the skill level. The skill level was either characterized as novice or expert based on pre-test results which were scored using a weighted scale. Bot of these variables were categorical variables coded with a 0 or a 1. In this case, referred to the absence of the Microsoft Office Assistant or to being a novice computer user. 1 referred to the presence of the Microsoft Office Assistant or to being an expert or experienced computer user. Then they were given 15 minute to complete a task using Microsoft Excel. The task consisted of computing the mean of two data sets and graphing the mean levels of each data set. Once the completed the task, they were given a post-test questionnaire to fill out which asked them questions about their experience with the computer. It was hypothesized that (a) computer novices who have the Microsoft Office Assistant present will rate the computer higher than those who do not; and (b) there would be no difference between the two groups of experts.

The mean levels and the standard deviations (in parentheses) of the subjects' perceptions of the computer are in the table below. The higher the mean, the m positive the perception.

	Assistant	No Assistant	t-test significanc
Novice	3.00 (.1365)	1.73 (.733)	.067
Expert	3.60 (.5193)	4.21 (.9375)	.497

Table 6. Perception of computer by novice and expert excel users with and without the assistant

The results were as expected. The difference between the group of computer novices who had the Microsoft Office Assistant present rated the computer high than those who did not, and it was statistically significant. And also as expected, the difference between the two groups of experts was not statistically different. This indicates that including the Microsoft helper is a sound design decision—it helps the novices but does not bother the experts enough for it to be a nuisance

WHY DOES THE MEDIA EQUATION HAPPEN?

There have been previous reports in the human computer interaction literature o this form of "psychologism" or "intentional stance" being adopted by users. Two good examples are Sheri Turkle's ethnographic study of children working with computers and Wizenbaum's reports on people's reactions to his computer program ELIZA. Turkle reported that children seem to see these machines as being "psychological devices." She argued that this was just children playing wit psychological ideas and that as adults we would not (and do not) do this. Howev research shows that adults do the same thing (Reeves & Nash, 1996). It is just t they do not admit to doing so. Weizenbaum's (1974) reported that people relate to ELIZA (a piece of software) in ways that were very personal and intimate. In f this prompted him to quit research into this area of Artificial Intelligence.

One of the most important issues to note is that this "social" response towards interactive media is triggered not just by interacting with some fancy graphic voice-driven interface but even by interacting with a plain text interface (ELIZA i good example). It seems that users automatically and unconsciously apply soci rules to their interactions with computers—though they explicitly deny believing that computers have feelings or intentionality. As Nass and Reeves say, these responses are "easy to generate, commonplace, and incurable." This automacit of response indicates that this response is deeply instinctual and not available t conscious introspection. We argue that this "intentional stance" is an artifact of t way our minds were designed by natural selection. Just as our visual system did not evolve to work under artificial light, our mental modules did not evolve to wor with interactive technology. We shall attempt to show that the findings of the me equation research (specifically with interactive media) make sense only from wit the perspective of evolutionary psychology and its argument for a "Theory of Mi Module (ToMM)"

Evolutionary Psychology

Evolutionary psychology is a new discipline that argues that the evolutionary pa provides the key to understanding our modern behavior (Barkow, Cosmides, & Tooby, 1992; Crawford, & Kerbs, 1998; Simpson, Kenrick, 1997). This approach has had a significant impact on the fields of sociology, anthropology and cogniti science (Cosmides, 1989, Cosmides & Tooby, 1992, Pinker, 1997). The goal of research in evolutionary psychology is to discover and understand the design of the human mind using the theoretical framework of evolutionary biology. Accordi to this view the mind is a set of information processing modules that were designed by natural selection to solve adaptive problems faced by our hunter-gatherer ancestors. This research indicates that our brains come equipp with functionally specialized independent modules (which William James called "instincts") for performing cognitive tasks. Instincts formed through 10 million ye of human evolution are not overridden by a few thousand years of cultural evolution. As Tooby & Cosmides say:

> *The computer age is only a little older than the typical college student, and the industrial revolution is a mere 200 years old. Agriculture first appeared on earth only 10,000 years ago, and it wasn't until about 5,000 years ago that as many as half of the human population engaged in farming rather than hunting and gathering. Natural selection is a slow process, and there just haven't been enough generations for it to design circuits that are well-adapted to our post-industrial life.*
>
> *In other words, our modern skulls house a stone age mind. The key to understanding how the modern mind works is to realize that its circuits were not designed to solve the day-to-day problems of a modern American – they were designed to solve the day-to-day problems of our hunter-gatherer ancestors... knowledge about intentions, beliefs, and desires, which allows one to infer the behavior of persons, will be misleading if applied to inanimate objects... the crib sheet that helps solve problems in one domain is misleading in another. This suggests that many evolved computational mechanisms will be domain-specific: they will be activated in some domains but not others. Some of these will embody rational methods, but others will have special purpose inference procedures that respond not to logical form but to content-types -- procedures that work well*

> *within the stable ecological structure of a particular domain, even though they might lead to false or contradictory inferences if they were activated outside of that domain.*

Thus our minds are adapted to surviving in the African Savanna, in small foragin bands not in the contemporary world we live in today. The agricultural revolution barely 5000-10,000 years old, and the industrial revolution barely 200. Before there was print and photography, the only images we received was from the real world. As Pinker (1997) says,

> *Before opiates came in syringes, they were synthesized in the brain as natural analgesics. Before there were movies, it was adaptive to witness people's emotional struggles, because the only struggles you could witness were among people you had to psych out every day. Before there was contraception, children were unpostponable, and status and wealth could be converted into more children and healthier ones. Before there was a sugar bowl, salt shaker, and butter dish on every table, and when lean years were never far away, one could never get too much sweet, salty, and fatty food (p. 207).*

Perceiving Pictures: Evolutionary Explanations

Often when talking of people interacting with new media it is argued that intentionality is something that can be argued away or overcome through learnin However this "intentional stance" is not easily overcome. Just as certain visual illusions (such as the Muller-Lyer illusion) do not go away even when we know what "reality" is (such as the lines are of equal length in the Muller-Lyer illusion); these "cognitive illusions" persist despite our knowing otherwise. Humans tend t approach their daily life with acceptance rather than doubt (Gilbert, 1991)—and instinctually tend to accept what seems real as being real. Visual perception of pictures has been an area that has been studied in great detail and we believe c help us understand our responses to interactive media.

Perceiving illustrations is, in a very fundamental way, different from perceiving t world around us. Pictures are not natural. Previously, all objects in themselves were important or could be safely ignored. But pictures, though trivial in themselves, mere patterns of marks, are important in showing absent things. Biologically this is most odd since for millions of years animals had been able to respond only to present situations and the immediate future. Pictures, and other symbols, allow responses to be directed to situations quite different from the present; and may give perceptions perhaps not even possible for the world of objects. This is their strength, yet it may be where they can go wrong as well.

Pictures have a double reality. Drawings, paintings, and photographs are object their own right—patterns on a flat sheet—and at the same time entirely different objects to the eye. We see both a pattern of marks of paper, with shading, brush-strokes or photographic 'grain', and at the same time we see that these compose a face, a house or a ship on a stormy sea. Pictures are unique among objects; for they are seen both as themselves and as some other thing, entirely different from the paper or canvas of the picture. Pictures, as the psychologist Richard Gregory says, "are paradoxes" (Gregory, 1970, p. 128). The paradoxica nature of pictures is that they must convey information about a world (a three-dimensional world) through marks on a two-dimensional surface. It is impossible to determine the structure of a three-dimensional from a two-dimensional picture. However, our mind makes a "leap of faith" about how things are arranged in the real world and uses that information to "see" objects (people, things, animals etc.) in scribbles on a piece of paper. Even monkeys reared in isolation show appropriate emotional responses to objects shown only photographs (Dunbar, 1996).

> *Our perceptual machinery for making use of retinally available information about the disposition of objects in three-dimensional space is deeply entrenched in our nervous system and wholly automatic in its operation. Without our bidding or even our awareness of its existence, this machinery immediately goes to work on any visual input, including the visual input provided by a two-dimensional drawing. As a result, we cannot choose to see a drawing merely as what it is—a pattern of lines on a flat, two-dimensional surface. To the extent that that pattern of lines conforms with the rules of linear perspective, for example, that pattern automatically triggers the circuits in the brain that makes the three-dimensional interpretation appropriate to such a perspective display. Any consciously adopted intentions to ignore such an interpretation are largely powerless against the swift deliverances of this underlying machinery. This should not surprise us. We have inherited this machinery from individuals who, long before the advent of picture making, interpreted—by virtue of this machinery—what was going on in the three-dimensional world around them with sufficient efficiency to survive and to continue our ancestral line. (Shepard, 1990 p. 126-7)*

Our focus on evolutionary psychology is in its implications for understanding ho people work with interactive media. We argue that this "intentional stance" (Dennet, 1987) towards media can be understood by looking at the results of so current research in areas such as developmental psychology, cognitive psychology, social psychology and anthropology. It has been argued (Dunbar, 1996; Plotkin, 1997) that the human mind and its higher intellectual functions—i. reasoning and thought —evolved not for the gaining of simple factual knowledg about the world , not for mastering of skills and methods for exploiting resources and not even for learning such facts or skills by observing and imitating others, rather in order 'to hold society together.' Social life "involves the preservation of group structure in the face of individual tendencies to exploit and manipulate others; individuals must calculate the consequences of their own behavior and assess the likely behavior of others on the basis of projecting themselves into th place of others—reasoning that 'I would do such-and-such in his or her situation but he or she is different from me in this and that way, and therefore I can expec him or her to do the following, which I can influence by behaving like so or like s Every social creature has to balance between exploiting the benefits of group liv (safety, better food resources, better care of offspring) and suffering its costs (being cheated by your spouse or other members of your group—the so called "free rider problem") as well. This creates an arms race of one-up-man-ship and forces social creatures to become smarter. Social animals (such as bees, parrot dolphins, elephants, wolves, sea lions, monkeys, gorillas and chimpanzees) are usually the largest-brained and the exhibit the smartest behavior. These animals have complex signalling systems to receive signals to coordinate hunting, foragi defense, and sexual access. They also have complex mechanisms for exchangi favors, repaying and enforcing debts, and detecting cheaters.

One of the most fundamental specialized cognitive modules predicted by Evolutionary Cognitive Psychology is the "Theory of Mind Module (ToMM) (Pinker, 1994, 1997;

Baron-Cohen, 1995; Leslie, 1988; 1994) that infers a full range of mental states from behavior. This module works as a "crib sheet" allowing humans to take the "blooming buzzing confusion" around us and infer appropriate social behavior. Research shows that, babies less than a year old can differentiate between inanimate and animate objects, by distinguishing between those that move only when acted upon from ones that are capable of self-generated motion. They als assume that the self-propelled movement of animate objects is caused by invisi internal states-such as goals and intentions. These invisible states have to be inferred since they cannot be seen. As Pinker (1997) says:

> *Our common sense about other people is a kind if intuitive psychology—we try to infer people's beliefs and desires from what they do and say, and try to predict what they will do from our guesses about their beliefs and desires. Our intuitive psychology, though, must make the assumption that other people have belifes and desires; we cannot sense a belief or desire in another person's head the way we smell oranges... We have to make fallible guesses from fragmentary information. Each of our mental modules solves its unsolvable problem by a leap of faith about how the world works, by making assumptions that are indispensable but indefensible—the only defense being that the assumptions worked well enough in the world of our ancestors (p200).*

Our experience of other minds evidently is the product of highly sophisticated an deeply entrenched inferential principles that operate at a level of our brain that i quite inaccessible to conscious introspection or voluntary control (which is why people are surprised by the results of the media equation). When we see a serie of squiggles on a piece of paper we do not first experience a two-dimensional image and then consciously calculate or infer a the external three-dimensional scene that is most likely, given that image. The first thing we experience is the three-dimensional world—as our visual system has already inferred it for us on t basis of the two-dimensional input. Similarly when we interact with a computer w automatically switch on the circuits for social behavior. This is a form of what Hermann von Helmholtz, called "perception as unconscious inference".

Of course these circuits that get switched on are not purely innate. They have a strong cultural component as well. For instance in the study on native and non-native speakers presented above it is clear that nativeness and non-nativeness is not something we are born with. These are learned through enculturation. What seems innate however is the fact that we deal with interactiv media just as we would with a real person. Our ability to create these interactive artifacts, which emerged only recently on an evolutionary time scale enables us present stimuli to our minds that could only have been from other "intentional actors" such as animals or other humans in the past.

IMPLICATIONS FOR EDUCATION

The media equation founded in the evolutionary psychology perspective offers a number of implications for education technology. To begin with, it forces us to reevaluate the conception of the computer and other forms of media as mere to potentially permitting us to reinterpret and glean new insights from existing research that frequently appears to be "all over the place" or even contradictory. For example, a large body of literature exists addressing the issues related to computer anxiety. However as this literature does not produce any consistent answers to questions such as "what is computer anxiety" and "how can we prev it?" Zhao, Worthington, and Ropp (1998) argue that "computer anxiety as a construct involves more than simple physical interactions with a computer. Computers, like Rorschach inkblots represent different images for different peop reflecting their fears, hopes, dreams and desperation." This imposition of intentionality on media presents a completely fresh perspective for understandin the computer anxiety literature—to offer a theoretical perspective where none existed before.

Furthermore, this new theoretical perspective may allow for the extension of previous research in education to the rapidly expanding field of educational technology, reducing needless replication. Research in teacher practices, for instance, contains several investigations revealing how the achievement of students is affected by the mechanics of teacher instruction. Although attempts application from this data are not well received by teachers and arguably inappropriate because they are insensitive to classroom dynamics, because the media equation would suggest that the same rules govern how students would respond to both a real and mediated instructor, these findings find new value in their application to educational software and media design.

A fundamental grounding in the conceptual underpinnings of the media equatio informed by cognitive, social, and evolutionary psychology may well provide the potential for a more facilitative learning environment in addition to preventing countless errors in the design of educational media. The research into media demonstrates that not only do we respond to interactive media in a manner typic to our dealings with other people, but that very minimal cues are all that is necessary to initiate a fairly extensive conception of "who" this other social actor These evolutionarily advantageous rules of thumb for recognizing other social actors and intuiting intentions, honed by cultural experiences, can thwart the educational goals of media if not taken into account. Traditionally, educational media has been viewed as a way to provide a patient tutor, while simultaneousl sidestepping issues of attitudes and stereotypes. The media equation reveals th this may be a goal that is doomed from the start. We are meaning-makers and pattern-seekers and even when the information is terribly diluted or meager we try and make some sense of it – and that will influence our actions.

Designers of educational technology can focus on harnessing this natural reacti to interactive media to our advantage. For example, SCRT data and some preliminary data from one of our studies (not presented here) indicate that perceived "otherness" can reside in another machine, a paper and pencil survey another voice on the same machine, and can even be "kicked in" with a simple change of font and colors. This holds obvious implications for the evaluation and testing in and of online distance education courses. If we can't prevent students from constructing an identity for their mediated instructor, we have the option of carefully constructing that identity for them, an identity that will further our educational goals, not frustrate them. For example, a computerized tutorial that teaches with a "personality" designed to interact in an optimal fashion with that its student (i.e. submissive style matched with a submissive student) may be possible and advantageous.

However, attention must be given to the delicate balance of educational aims. Is acceptable to further a cultural stereotype by employing a masculine voice, or a native language speaker, to teach a lesson, if research indicates that such a tut is perceived as more authoritative and knowledgeable, in order to maximize the knowledge retained by our students? Is it in education's best interest to flatter software users, undeservedly, because it raises attitudes toward the software, t subject at hand, or improves learning? These and other issues will have to be carefully considered when applying media equation research to the developmen of educational media.

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