



A theoretical model of differential social attributions toward computing technology: when the metaphor becomes the model

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This paper explores the use of metaphorical personification (anthropomorphism) as an aid to describing and understanding the complexities of computing technologies. This common and seemingly intuitive practice (it “reads”, “writes”, “thinks”, “is friendly”, “catches and transmits viruses”, etc.) has become the standard by which we formulate our daily communications, and often our formal training mechanisms, with regard to the technology. Both anecdotal and empirical sources have reported numerous scenarios in which computers have played a noticeably social role, thus being positioned more as a social actor than as a machine or “neutral tool.” In these accounts, human behavior has ranged from making social reference to the device (“It’s really much smarter than me.”), to more overt social interactions including conversational interplay and display of common human emotions in response to an interaction. Drawing from behavioral psychology and attribution theory, a theoretical model of the phenomenon is offered from which several propositions are advanced regarding the nature of the behavior, positive and negative implications associated with extended use of this metaphor, and recommendations for research into this ubiquitous social phenomena.

... I have encountered these situations before, and in every case they were the result of human error.

-HAL 9000

from Arthur C. Clarke’s *2001: A Space Odyssey*

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1. Introduction

The pervasiveness of information technology (IT) in our society has led us to accept as commonplace the mediation of our daily interactions with organizations and others through computers. IT is perhaps the most widely implicated phenomenon in the evolution of the world of tomorrow. Mankind expects its science and technology to stand at center stage in this evolution and nothing exemplifies the human dominion in this process more than the computer (Rule & Attewell, 1989).

The computer is often characterized as a vehicle for increased productivity through the automation of previously manual tasks. Still others see the computer as a medium for the extension of the human mind and body into areas of knowledge acquisition and physical achievements otherwise impossible without the computer (Buchanan & Boddy, 1983; Lehtonen, 1988; Zuboff, 1988). In one form or another, we have seen evidence of the value of computing technology in all of these areas. One prevailing metaphor used when describing our relationship with the computer is that of a "neutral tool" that aids users in working more efficiently (Hirschheim, 1986; Hirschheim & Newman, 1991; Winter, 1993). This neutral tool has as one of its mandates improvement of the productive and generative capabilities of humanity's endeavors. Unfortunately, however, these often expected increases in productivity resulting from the application of this neutral tool have not been universally realized (Weill, 1992; Markus & Soh, 1992; Sethi, Hwang & Pegels, 1993). Implicit in this is the possibility that either the computer is not as neutral as we characterize it to be or, given neutrality as its true nature, we still lack a clear understanding of how and when to effectively apply its capabilities. Perhaps this lack of complete awareness is related in some way to how we teach others and ourselves about the technology and thus come to refer to it and think of it in our daily lives.

The common and seemingly intuitive practice of ascribing human-like characteristics to computing technologies (it "reads", "writes", "thinks", "is friendly", "catches and transmits viruses", etc.), is an example of *anthropomorphism* or *anthropomorphic behavior*. Such behavior has become the standard by which we formulate and design our daily communications, and often our formal training mechanisms, with regard to computing technologies. As the capabilities of the computer expand and many new roles for it evolve, an important question begins to emerge: What criteria will we use to distinguish humanity from technology (Nass, Lombard, Henriksen & Steurer, 1995)? Notwithstanding the anthropological debate concerning the origin of man (Bowden, 1977; Berra, 1990), scholars have argued humans to be unique because they can make tools, learn crafts, communicate through language, and manipulate symbols (Bolter, 1984). What, then, will people believe distinguishes humans from the present and future thinking machine? Admittedly, while there are thousands of ways in which computers are different than people, there are a few potentially significant ways in which they are highly similar. Computers use language, respond based on multiple prior input, fill roles traditionally held by humans, and are capable of producing human-sounding voices. These, often extreme, social cues have until recently only been associated with other humans (Moon & Nass, 1996).

The ubiquitous nature of the computer and the phenomenon deriving from the common anthropomorphic metaphor are potentially related to both positive and negative outcomes for individual and organizational users. At operational levels, the more

human-like the responses to the computer on the part of users, the more they are thought to generate improved results in productivity and customer responsiveness. The use of anthropomorphism in user interface design may serve to make new software packages easier to learn and use, generating greater levels of interactivity and prompting the learner to achieve more positive outcomes in the learning process. The ability of decision makers to interact with the computer which is capable of retaining, retrieving and analyzing vastly more data than its human user can elicit increased confidence in decision-making processes.

Conversely, the anthropomorphic metaphor may lead certain individuals to an expectation of computing technology that is unrealistic. The lack of clear distinctions regarding the computer's capabilities and its role may make support of some operational decisions problematic, with users relying too heavily on the computer for support of non-structured decision-making. Evidence suggests that the resulting confusion has brought some users to the unfortunate situation in which the computer was expected to generate a decision when the human decision maker was unable or unwilling to take action. Training can also be affected, with users feeling satisfied with the training effort, but not achieving additional levels of learning (Angehrn & Nabeth, 1997). Mayer & Bromage (1980) showed that learning with concrete models, such as the anthropomorphic metaphor, resulted in better general ideas and more inferences and intrusions than learning without them. However, subjects learning without the models retained technical information significantly better. The implications of this issue for increasing our effectiveness in education (McCredie, 1999), social informatics (Kling, 1999) and commerce (Shapiro & Varian, 1998) among many others, are far reaching. Given this, it seems that the potential for both positive and negative outcomes associated with the use of the anthropomorphic metaphor and their subsequent societal implications warrants the development of a richer understanding of the phenomenon.

The objective of this paper is four-fold: (1) to explore the common practice of using metaphorical personification (anthropomorphism) as an aid to describing and understanding the complexities of computing technologies, (2) to offer a theoretical model regarding the phenomenon of social interaction with computing technologies, drawn from behavioral psychology and attribution theory (Heider, 1958; Jones & Davis, 1965; Kelley, 1967, 1972, 1973), from which several propositions are advanced, (3) to discuss the implications of this phenomenon (anthropomorphism) with regard to interface design, development of increased computer literacy training and issues surrounding the introduction of technology to the workplace, and (4) to provide the academic research community with a foundation upon which empirical research into this, and other related, phenomena can be based.

2. Anthropomorphism and computing

Anthropomorphism is the ascription of human-like attributes and characteristics to an otherwise non-human object (Tamir & Zohar, 1991; Stebbins, 1993). It is arguably the most common metaphor used in the computing domain (Johnson, 1994). Despite recent attention, the illumination of the nature of machines through the use of human metaphor, and vice versa, is not a phenomenon grounded in the 20th century (MacCormac, 1984). La Mettrie (1912), for example, published his famous *Man à Machine* where

TABLE 1
Common anthropomorphisms and technomorphisms

Anthropomorphisms	Technomorphisms
read	“core dump”
write	“debugging a problem”
think	“stuck in a loop”
storing	“does not compute”
memory	“memory (data) banks”
retrieve	“interface with”
friendly	“clear the buffer”
remember	“reprogramming”
learn	“hardwired”
infected with a virus	“default solution”
teach	
smart	
cheats	
caring	
understands	
intelligence (artificial)	

he compared the human body to a “finely crafted watch”, the brain to a “magic lantern”, and even the soul to an “enlightened machine”. Modern social psychology often uses systems theory (Bertalanffy, 1962, 1968) to assist in describing and understanding human behavior and decision patterns. Increasingly, social scientists want to study the processes surrounding the introduction of computers into an organizational setting or the application of computing technologies as a surrogate for human interaction, something akin to a social actor. We suggest that the elusiveness of a simple description of the essential nature of the computer has resulted in a reversal of La Mettrie’s treatise: the use of the *Machine à Man* metaphor.

Computers are commonly associated with cognitive processes that often seem, at least superficially, analogous to those which go on in people (Turkle, 1980). In constructing the vocabulary necessary to describe the actions and capabilities of information technology, we have chosen the most familiar of foundations to build upon: ourselves. In our efforts to reduce the complexity of the technology to a more manageable level, we have found it convenient to relate well-known processes associated with human beings to the machine.

Computers, too, introduce a new vocabulary to those who work with and around them. Over time, this new lexicon has become conveniently intertwined with our descriptions of ourselves in a manner that conveys an immediately understandable message when used in daily conversation. This intertwining of man-machine vocabulary can be thought of as *technomorphism*, the ascription of machine characteristics to the behaviors and cognitive processes of humans. Table 1 provides a brief list of the most common anthropomorphisms applied to information technology as well as some of the common technomorphisms becoming increasingly noticeable in daily human conversation.

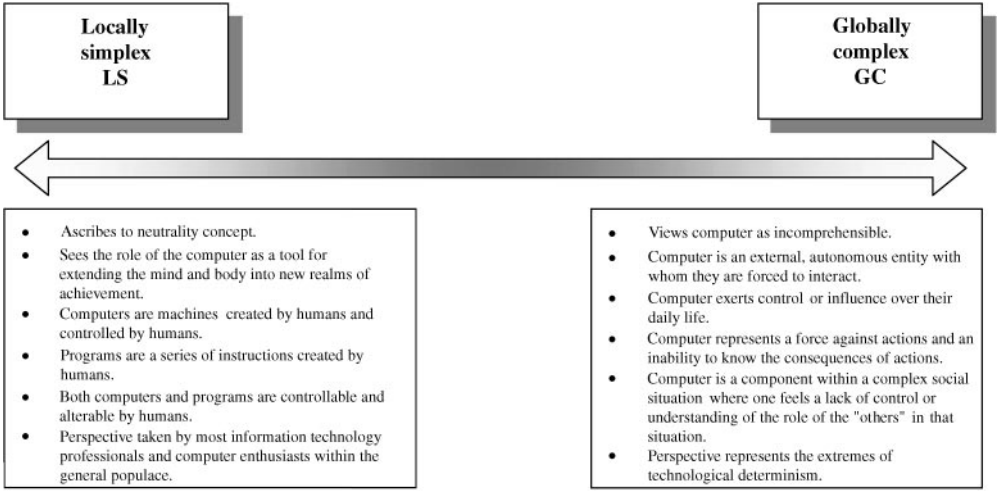


FIGURE 1. Computing technology continuum of perspective.

Ideas about computers have become charged with multiple meanings that reflect our attraction to the fusion of the physical vs. the socially constructed computer. While the physical perspective allows us to express *what computers do*, the socially constructed perspective exists from our efforts to understand *what computers are*. We propose that the way in which we think about *what computers are* is ultimately and irrevocably associated with our ability to determine *what computers can do*.

It is important to note that our contention is neither that the conscious use of anthropomorphic metaphor, nor the lexical institutionalization of it, is intrinsically or inherently damaging or bad. Rather, we contend that it may serve to encourage false or inappropriate attributions toward computing technologies. Both anecdotal and empirical evidence suggest that we take our personal sense of what is important, interesting and valuable about IT and tend to project it onto “computers in general” (Turkle, 1980, 1997; Nass & Steuer, 1993; Prasad, 1993). This argument suggests the possibility that discourse about information technology, and the methods by which we refer to it, may reflect more underlying social constructs, including organizational status, social comfort, domain literacy, need for a sense of belonging, affection and companionship, social alienation, power or invasions of privacy.

Extending this we can conceptualize a continuum of perspective with regard to computing technologies in social settings anchored by two different viewpoints. Figure 1 provides a graphic illustration of this conceptualization.

For those who ascribe to the neutrality concept and see the role of the computer as a tool for extending the mind and body into new realms of achievement, the technology is viewed as being *locally simplex* in nature. An individual with a locally simplex attitude sees the computer as just a machine created and programmed by humans and programs as just a series of instructions created by humans and, therefore, both controllable and alterable by humans. The computer represents both the foundation upon which to build and a tool that enables both the mind and body to be extended into otherwise

unattainable realms of accomplishment. Although admittedly an empirical question yet unanswered, it seems logical to expect that most information technology professionals and computer enthusiasts could be found toward the *locally simplex* (LS) end of the continuum.

At the opposite end of this continuum of perspective are those, however, that view the computer as “incomprehensible” or *globally complex*. An individual with a globally complex attitude sees the computer as an external, autonomous entity with whom they are forced to interact, and which exerts some type of control or influence over their life. This mysterious object represents a force against actions and an inability to know the consequences of actions. The attribution of human-like characteristics combined with the ever increasing, seemingly rational behavior of computing technologies can create the impression of a rational actor (Goffman, 1959) with whom the members of the *globally complex* (GC) group must learn to cope. This misunderstanding, may allow or encourage those with a GC perspective to perceive (and possibly act upon) autonomy of the computer. This behavior may be thought of as similar to that which is created in a complex social situation where one feels a lack of control or understanding of the roles of the “others” in that situation. Two common examples of this perceived autonomy are the belief that “computers invade privacy” or that “computers cause a loss of jobs”.

However attractive it may be to suggest that individuals may generally view computing technology† as being somewhere between globally complex or locally simplex, it fails to explain what leads them to understand computing technology in this manner. As individuals are faced with new technologies, we suggest they are likely to utilize an attribution process which is influenced by their own characteristics, the characteristics of the computing technology and the types of interactions they have with it.

3. A model of the computer as a social actor

To better understand this phenomenon and to move toward a deeper analysis of it, we propose a theory-derived model containing measurable constructs associated with the anchors of our continuum of perspective. We propose that the degree to which a particular perspective dominates is directly related to four distinct elements: (1) the *social character* of the computing technology, (2) certain *core self-evaluations* made by the individual, and (3) the context and nature of the interaction with the computing technology, and (4) the presence or absence of certain *attributional information cues*. These four elements serve as inputs to a process the result of which is the generation of an attribution with regard to the computing technology of interest and, over time, with computing technology in general. Figure 2 contains a graphical illustration of this

† It is important to clarify our intention with regard to the use of the phrase “computing technologies”. We are using this term to describe the interaction between a person and some computing technology in a computer-mediated activity. In other words, if the person is aware of the presence of a computing technology within the context of the interaction then no further distinction with regard to what type of computer or system is either necessary or relevant to this discussion. While we fully acknowledge that the term has technical connotations that are much richer and more complex than the definition we are using, we submit that the degree to which a non-computer professional would be able to describe or recognize those distinctions is questionable. For the purposes of brevity and clarity, all references herein to *computing technologies*, *computers* or simply the use of the word *technology* will assume this definition.

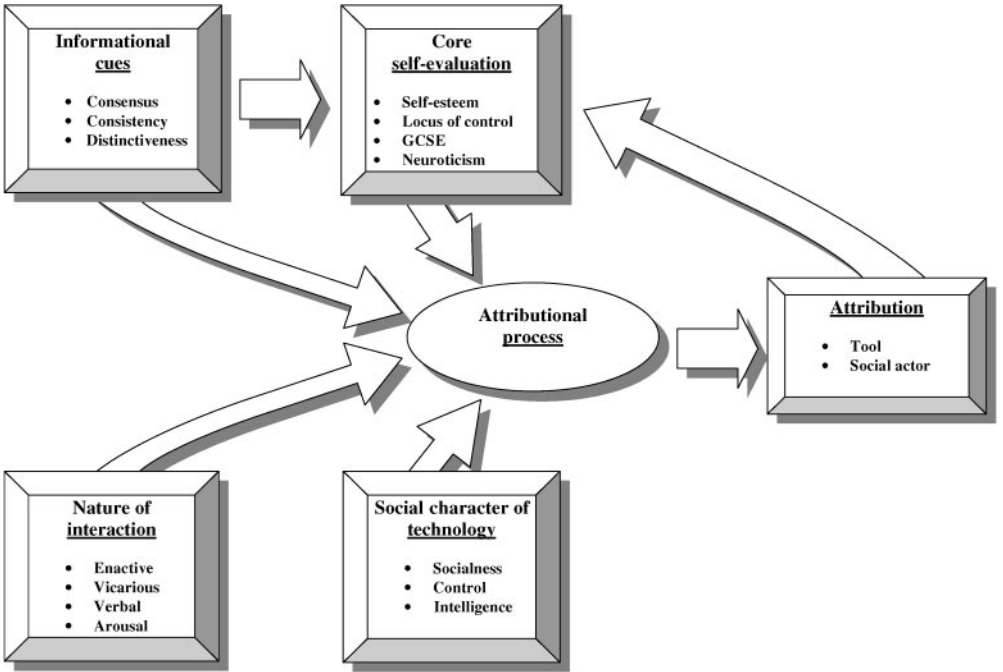


FIGURE 2. Model of computer as a social actor.

stimulus–response‡ characterization and the relationships between the process and the four inputs.

3.1. THE ATTRIBUTION PROCESS

As shown in Figure 2, we propose that several elements converge as inputs to an attributional process which results in an attribution of the computing technology as either a tool or a social actor. The exact nature of this process has not been detailed herein, however, as we believe it to be beyond our current understanding of cognitive systems and thus beyond the scope of this paper. Therefore, at this stage of our exploration, our focus is more on the inputs to the process rather than the process itself. Conceptually, we regard each of these elements to be independent of the others but we believe that the degree to which the final attribution is reinforced over time may create a type of “exacerbation cycle” in terms of its effect on the core self-evaluations element in the model. While there is a potential for labeling this portion of the model as conjecture, the malleable nature of the core self-evaluations (as described below) dictates its inclusion in the model. Below, we describe the components of each of the specific elements in the model in greater detail and provide justification for their inclusion.

‡It is important to note that we are not yet prepared to characterize this phenomenon in terms of a conventional causal model, thus our decision to offer a stimulus-response process. The positioning of the elements are intended to represent a temporal precedence rather than cause and effect positioning. We will leave the ultimate issue of specific causality to future empirical work.

3.2. NATURE OF INTERACTION

It is through our wide variety of experiences with computers that we begin to form our attitudes about what computers can and cannot do. We learn how to interact with them based upon the cues we receive and we form rules for our behavior during those interactions.

Bandura (1977, 1978, 1986, 1997) suggests that there are multiple types of interactions through which information can be gathered. Each of these types of interactions vary both in their ability to support learning processes and in the conveyance of information. The first of these is called *enactive mastery*. This interaction type occurs when we actually physically work with a particular object or directly interact in a particular situation. In a wide variety of domains, enactive mastery has been found to be the most powerful conveyer of information (Bandura, 1977; Gist & Mitchell, 1992; Marakas, Yi & Johnson, 1998).

The second type of interaction which can provide information cues is *vicarious experience*, or interaction via watching someone else interact with the person or object. Although not thought to be as powerful a source of information as enactive mastery, several studies have shown that vicarious experience is, nonetheless, a powerful means of conveying information useful in the formation of attitudes (Compeau & Higgins, 1995; Latham & Saari, 1979; Manz & Sims, 1981, 1986; Yi, 1998).

The third type of interaction is *verbal persuasion*. Often we rely on others to provide feedback that serves to either inform us regarding a new experience or to reinforce us with regard to the formation of our attitudes and beliefs. The verbalization of experiences and the exchange of these experiences with others can be thought of as a form of interaction and, thus, a source of information regarding the computing technologies with which we interact.

The final information source is *emotional arousal*. In this type, as we interact with an object or person, we rely on our psychological and physiological arousal in forming judgments about the situation. Emotional arousal is thought to convey information regarding the degree of vulnerability we face in a situation (Bandura, Adams & Beyer, 1977). We suggest that people will gather information about computing technology from multiple sources, not just through their own interactions with it. They are also likely to gather information about computers by watching someone interact with them, by watching advertisements about technology or simply by talking about past and future interactions. Given this, we see the nature of the interaction to be an important input to the formation of an attribution regarding the technology.

3.3. SOCIAL CHARACTER OF THE TECHNOLOGY

Social interactionism literature provides us with three predominate characteristics to indicate that one is interacting with a social actor. First, language use has been argued to be at the foundation of human social action (Winograd, 1972). Before the advent of information technology, language was the primary distinguishing feature of humans from other living beings (Brown, 1988). A number of studies have shown that human-sounding speech is processed differently by humans from other acoustic stimuli and is normally associated with human-to-human relationships. Nass & Steuer (1993), however, have shown that natural-sounding speech generated by a computer encourages the use of attributional rules normally reserved for strictly human relationships.

Nass and his colleagues have demonstrated that social cues, such as a human-voice emanating from a computer, can elicit responses from subjects that suggest a distinct social posturing. Their experiments have shown that subjects act as though the computers were motivated by self-interest and were even sensitive to criticism (Nass, Steuer, Henriksen & Dryer, 1994; Nass, Steuer & Tauber, 1994). Further, findings obtained by Moon and Nass (1996) suggest that computer personalities are psychologically "real" to users. In other words, the psychological responses of the subjects were identical regardless of whether the personality they were interacting with was embodied in a human being or a computer. Further, their results show that different responses to male and female voices, authoritative vs. non-authoritative voices tactful/tactless voices and honest/dishonest voices are consistently observed. From this work, and that of others, findings suggest that even the most objective of computer feedback can elicit psychological and emotional responses from users [see Reeves & Nass (1996) for summary of this research]. Given the emergence of alternative methods of interaction with computers, such as voice recognition systems and virtual reality simulation environments, the social implications of this phenomenon may be both significant and broadly variant.

Second, Rafaeli (1986, 1990) suggests that interactivity, or the extent to which an entity's response is based on multiple prior inputs rather than on the immediately prior input, promotes the desire to impute social characteristics to that entity. The nature of artificial intelligence (AI) and expert systems (ES) promote this sense of interactivity. Finally, social development literature contends that individuals define themselves and others as humans by observing the social roles that they and others fill (cf. Cooley, 1966; Berger & Luckman, 1967). Information technology can be seen in a number of apparently social roles: as teacher or tutor, doctor, counselor, monitor, communicator or facilitator.

Given the right set of contextual cues, people exhibit social responses to a broad range of media, including computers, even when they profess that to do so is inappropriate (Nass & Steuer, 1993; Nass *et al.*, 1996; Fogg & Nass, 1997; Moon & Nass, 1998). Several authors provide evidence as to what these cues might be. Turkle (1984, 1997) provides evidence that people can, and often do, perceive intelligence, emotions and social responses in technology. Likewise, Sproull, Subramani, Kiesler, Walker and Waters (1996) empirically demonstrated that technology can be perceived on social, intellectual and emotional dimensions. From this, we have proposed three categories of social characteristics that could be present singularly or collectively when interacting with computing technology: (1) *socialness*, (2) *control* and (3) *intelligence*. Perceptions of *socialness* occur when the individual interacting with the technology senses cues in the technology which suggest a predominately organic, rather than mechanistic, response to their actions. This might include social characteristics such as whether the technology is perceived as enjoying the interaction, how "friendly" the technology is perceived to be, or how well the technology appears to cooperate with the individual. Also, such perceptions could occur when the individual interacting with the technology perceives emotional characteristics within the technology such as joy, anger, fear or other common human emotions.

Perceptions of *control* occur when the interaction with the technology is such that the individual is being directed or supervised in a proactive manner by the technology. Such

perceptions might evolve from situations where the technology is perceived to be forbidding an action or directly enforcing a set of behaviors. Finally, perceptions of *intelligence* exist when the individual perceives knowledge, purpose and intelligence within the technology.

Given the degree to which it has been demonstrated that such characteristics can be successfully embedded with computing technology and can, likewise, be successfully perceived by subjects interacting with it, it seems reasonable to assume that the social characteristics of the technology serve as an important input to the attributional process of interest.

3.4. CORE SELF-EVALUATIONS

Judge, Locke and Durham (1997) propose the concept of *core self-evaluation* which refers to the fundamental, sub-conscious conclusions individuals reach about themselves, others and the world. Judge, Locke, Durham and Kluger (1998) describe four specific core self-evaluations and empirically test a model based on the concept. Their findings suggest a significant relationship between the core evaluations and perceptions of work characteristics, job satisfaction and life satisfaction. We believe that this explication of self can serve as both a useful and appropriate method of modeling the individual characteristics that may contribute to the formation of the perception of a computer as either a tool or as a social actor. Below we describe each of the specific evaluations contained within the proposed model.

3.4.1. *Self-esteem*

Self-esteem (SE) refers to the basic, overall appraisal one makes of oneself. Judge *et al.*, (1998) suggest that SE serves as the most fundamental of core evaluations of the self because it represents the overall value that one places on oneself as a person (Harter, 1990). Brockner (1988) describes differences between high and low SE individuals as manifesting themselves in “the way they think, feel, and perhaps most importantly, behave (p. 1).” He further posits that low SEs are “behaviorally plastic (p. 6)” in that their work motivation and performance are more susceptible to influence by external cues than that of high SEs. Specifically, Baumeister (1982) suggested that persons high in SE are more likely to engage in compensatory self-enhancement behaviors (e.g. self-presentation effects) when confronted with negative feedback from others. In contrast, however, those with low SE do not tend toward compensatory self-enhancement behaviors in the face of negative feedback since they regularly anticipate disappointment and rejection. Instead, low SEs seem to behave as if they were constrained to make their self-presentations consistent with what others expect thus further reinforcing their negative self-evaluation. Within the realm of computing technologies, Resnik and Lamers (1985) found that neither the compensatory self-enhancement behavior of high SEs nor the consistency of negative self-image behavior of low SEs was triggered by negative feedback from a computer with impersonal, machine-like features but was, however, significantly triggered by negative feedback from a computer with personal, human-like features. Their data suggest that the concept of “user friendly” goes beyond describing an interface which is easy to navigate or one that displays anthropomorphic characteristics.

The assumption that all who must interact with a computer want software that is “user-friendly” in the anthropomorphic sense may not be a realistic premise and that a perception of “user-friendly” may actually depend on such individual differences as self-esteem. Given this, we find it reasonable to suggest that SE may play an important role in better understanding the environment of the globally complex and, therefore, we include it in our proposed model.

3.4.2. *Locus of control*

Locus of control (LOC) reflects the degree to which an individual believes that he or she controls events in their lives (high internal) or believes that the environment or some external entity controls such events (high external; Rotter, 1966).

While admittedly, LOC is a relatively new variable in the computing domain (Kay, 1990) it has, nonetheless, been found to be associated with a number of computer-related issues. Griswold (1983) found that LOC explained the largest proportion of variation in computer awareness among college-level education and business majors. Kay (1990) found that general computer literacy (as well as individual literacy sub-scales including application software, awareness and programming) was found to be highly correlated with LOC ($r = 0.79$, $p < 0.001$). It is possible that individuals who possess a higher degree of computer literacy may perceive themselves as having more control over computers than those individuals who are novices by virtue of their domain knowledge or understanding.

Other empirical results suggest that LOC is a salient variable in the formation of attitudes toward computer interactions and can contribute to the formation of views of the computer as either a tool to be utilized or as a relatively autonomous entity which can perform the functions of human-like thinking (Lee, 1970; Cancro & Slotnick, 1970; Coovert & Goldstein, 1980). This polarization of thought can elicit reactions that range from adoption as a useful tool (LS) to perception of the device as a controlling entity (GC) (Feigenbaum & McCorduck, 1983). We argue that such an extreme is neither dysfunctional behavior nor uncommon. While the computer is certainly pervasive in our society, the vast majority of the world is still in the early stages of adoption and, therefore, in its understanding of it.

3.4.3. *General computer self-efficacy*

The third component of an individual's core self-evaluations is their sense of generalized self-efficacy. Self-efficacy is defined as an individual's judgment of their ability to execute courses of action required to deal with prospective situations. Efficacy judgments vary on three different dimensions: magnitude (one's perception of one's ability to perform a task), strength (the confidence one places in one's judgment of one's ability to perform) and generality (the range of activities included in the estimates of strength and magnitude). While generalized self-efficacy deals with perceived ability to interact in one's environment, this research is more concerned with an individual's perceptions of ability within the narrower domain of computing. The key self-efficacy variable thus becomes general computing self-efficacy (GCSE), which is defined as “an individual's perception of efficacy in performing specific computer-related tasks within the domain of general computing.” (Marakas, *et al.*, 1998, p. 128).

Although theoretically related to the LOC construct, GCSE differs in one important aspect. LOC is concerned with confidence in being able to control outcomes while self-efficacy (including GCSE) pertains to confidence with respect to task-specific actions or behaviors.

3.4.4. *Neuroticism*

Referred to as one of the Big Five personality dimensions, those individuals with a high degree of neuroticism are often prone to anxiety, exhibit tendencies to be fearful of novel situations, and may be susceptible to feelings of dependence and helplessness (Costa & McCrae, 1988). Neuroticism (also referred to as Negative Emotionality) acts as a negative lens through which the environment and an individual's interactions with it are interpreted. The construct can also be thought of as the number and strength of stimuli required to elicit negative emotions in a person. More resilient persons are bothered by fewer stimuli in their environment, and the stimuli must be strong in order to bother them. More reactive persons are bothered by a greater variety of stimuli, and the stimuli do not have to be as strong in order to bother them. Clark and Watson (1991) have demonstrated that high neurotics rate peers less favorably, view themselves as victims, and tend to be dissatisfied with their lives in general. We believe that neuroticism could be an exacerbating factor in those individuals of the GC perspective who struggle with the interpretation of the social role of computers.

3.5. ATTRIBUTION THEORY

Beyond the individual characteristics described above, we believe *attribution theory* provides a rich theoretical foundation for explaining both the possible sources and possible outcomes of anthropomorphic and social interaction with computers. The theory serves to explain the ways in which people try to determine why a particular behavior, either theirs or other's, occurred. It states that the attributes we connect with persons or objects determine our favorable or unfavorable attitudes toward these persons or objects (Pate, 1987). Applications of the theory are broad based and can be found in the literature of a wide variety of disciplines. Attribution theory is widely used in the field of social psychology to explain phenomena relating to areas such as career adjustment (Feldman, 1989), group performance (Phillips & Lord, 1982; Brown, 1984), performance appraisal (Landy & Farr, 1980; Ilgen & Feldman, 1983), leadership behavior (Pfeffer, 1977; Green & Mitchell, 1979; Cronshaw & Lord, 1987) and discipline arbitration (Bemmel, 1991). In addition, the theory has been applied to inform the study of cancer patients in medical research (Abrams & Finesinger, 1958), consumer behavior in marketing research [see Mizerski, Golden & Kernan (1979) for a review of applications of attribution theory in consumer behavior], motivation of sales personnel (Sujan, 1986; Teas & McElroy, 1986) and information technology research (Hughes & Gibson, 1987; Martinko, Henry & Zmud, 1996).

Attribution theory finds its roots in the work of Fritz Heider who noted a similarity between the goals and activities of scientists and those of people in everyday life (Ross & Fletcher, 1985). Heider's recordings, often referred to as his "naïve psychology", suggested that people, like scientists, strive to understand, predict and control the events that concern them. Through repeated observation, they form their theories about what is

occurring and constantly look for evidence to support, refute or modify those theories. Three basic assumptions form the basis for Heider's theory: (1) people try to determine causes of their behavior and the behavior of others, (2) individuals assign causal explanations for behavior in a systematic manner and (3) attributions that individuals may have consequences for future behavior or interactions (Dubinsky, Skinner & Whittler, 1989). Heider further suggested that both environmental and personal factors enter into the production of action and the construction of attribution of cause. He speculated that a "hydraulic relation" is perceived to exist between the causes within the person and causes within the environment. The more the person perceives himself as being the primary creator of the attribution of cause, the less causal influence the environment will be perceived to exert and vice versa. Heider also suggested that the determination of the causes of social events is important to individuals because it provides them with meaning and enables them to feel that they can predict and control their environment.

An interesting similarity exists between Heider's "naïve psychology" and the conceptualization of the situation offered in the classic work of Thomas and Znaniecki (1918–1920):

"... Every concrete activity is the solution of a situation. This situation involves three kinds of data: (1) the objective conditions under which the individual or society has to act, that is the totality of values — economic, social, religious, intellectual, etc.—which at the given moment affect directly or indirectly the conscious status of the individual or group, (2) the pre-existing attitudes of the individual or group which at the given moment have an actual influence upon his behavior, and (3) the definition of the situation, that is, the more or less clear conception of the conditions and consciousness of the attitudes." (p. 68)

In methodological terms, Thomas was an advocate of the comparative study of situations as the best approximation of the controlled experiment available to the sociologist (Stryker, 1980). Taking a similar perspective, Kelley (1967, 1972, 1973) has systematized and extended Heider's work into an explicit, hypothesis-generating set of principles. Kelley's work focuses on how individuals establish the validity of their own or of another person's impression of an object. According to Kelley's (1973) "model of covariation", the effect is attributed to the factor that is present when the effect is present and which is absent when the effect is absent. This perception of covariation can be greatly affected by a person's preconceptions about cause-effect relations, even to the point of being rendered wholly erroneous (Kelley & Michela, 1980).

In brief, Kelley's (1967) model focuses on the attributions made for an event in which a person behaves in some way toward a stimulus, under a particular set of circumstances. His theory attempts to predict the basis upon which an observer (either independent or embodied in the individual) will attribute the cause of the action or behavior to the person, the stimulus or the circumstances surrounding the stimulus or behavior. He extended his propositions (1972, 1973) to suggest that individuals typically make attributions on the basis of limited information. They are able to do this because they make use of personal theories or preconceptions about what causes are associated with what effects. Kelley refers to these preconceptions as *causal schemata*. Thus, a person can interpret cues and stimuli by comparing them to, and integrating them within an existing schema.

The principal implication of the covariation to principle this research is that certain patterns of information cues will lead to the formation of certain attributions. The sources of information used in understanding the event or behavior include: (1) *consensus*; whether others react in the same manner to this stimulus or situation, (2) *distinctiveness*; whether the same response occurs toward all similar entities and (3) *consistency*; whether the response to a stimulus or situation is the same over time and modality.

Depending on the pattern of these cues, individuals are likely to attribute the behavior to either characteristics of the stimulus or object, themselves (person), or the circumstances, or some combination of these. A stimulus, or object, attribution is an external attribution, where the individual sees the object or person with whom he is interacting being the cause for his attitudes or behaviors. A stimulus attribution is most likely to occur under an information pattern of *high consensus, high distinctiveness and high consistency* (HHH). Conversely, a person attribution is an internal attribution where the individual sees himself as being the cause for his attitudes and behaviors. A person attribution is most likely to occur under an information pattern of *low consensus, low distinctiveness and high consistency* (LLH). Finally, a circumstance or situation attribution occurs when individuals attribute their attitudes and behavior to be a result of the situation in which they find themselves. Circumstance attributions are thought to be most likely with an information pattern of *low consensus, high distinctiveness and low consistency* (LHL). While other information patterns can occur (i.e. LLL, HHL, etc.), the predicted attribution is not as clear and empirical results have often been equivocal. Under the other information patterns, the attribution is thought to reflect some combination of the person, stimulus or circumstance. Starting with McArthur (1972), years of research suggest that the hypothesized relationships between attributions and three strongest information patterns (HHH, LLH and LHL) are fairly robust (cf. Orvis, Cunningham & Kelley, 1975; Hewstone & Jaspars, 1987).

McArthur (1972) investigated Kelley's (1967) hypotheses in what has come to be considered the "classic" test of the theory. While her findings suggested that the subject's attributions were consistent with the predictions from the theory, she also found that the three information types differed in their relative importance for making the causal attribution. Consistency accounted for the most and consensus for the least overall variance. Further, McArthur's data revealed a strong bias toward stimulus attributions. Almost a decade later, Major (1980) found similar results and noted that over two-thirds of the subjects sought consistency information first. While other attributional information combinations are possible across the three dimensions (i.e. other than HHH, LLH and LHL), empirical results have been equivocal indicating they are likely to be more ambiguous in terms of their attributional significance [see Cheng and Novick (1990) for a review of this work].

While attributions toward a specific computing technology are, arguably, reflections of a more generalized view of technology, they may nonetheless differ from an individual's generalized view of computers. Computing technology attributions can be thought to vary from "tool" to "social actor" attributions. *Tool attributions* occur when an individual attributes the causes of his own attitudes or behaviors to be internal, not caused by the influence of the computing technology with which he is interacting. A *social actor attribution* occurs when the individual attributes the causes of his own attitudes or

behaviors to be dependent upon and/or influenced by the computer. An individual with a LS perspective would, most likely, view an attribution of social actor as a misattribution because, in fact, the computer is a tool, just like a hammer or a drill that can be used to assist us in our everyday tasks. To date, computers do not possess the capability to act independently or hold sway over our actions. The “misattribution” perspective, however, is much too narrow and fails to acknowledge that, despite the apparent inaccuracy in fact, the social actor attribution is often made. Turning to the work of Thomas (1928, 1937), we find a more reasonable perspective with regard to the apparent misattribution of social actor. Thomas believed that the situation, as well as its definitions, must enter any account of human behavior:

“The total situation will always contain more or less subjective factors, and the behavior reaction can be studied only in connection with the whole context, i.e., the situation as it exists in verifiable, objective terms, and as it has seemed to exist in terms of the interested persons.” (1928; p. 572).

We believe that great insight can be gained into the social actor attributions by embracing Thomas’ assertion, perhaps the most oft-cited phrase in the symbolic interactionism literature (Stryker, 1980), “If men define situations as real, they are real in their consequences, (p. 572)”. Taking this approach to the phenomena, we can argue that an individual may perceive the technology as influencing or controlling his behavior, but the technology, itself, cannot exert such control unless the individual allows it to. Just as with the tendency to hold anthropomorphic attitudes toward technology in general, these attributions reflect a continuum, with most individuals falling somewhere in between the extreme points.

Within the context of our proposed model, the pattern of HHH would result in a stimulus entity attribution (the computer is responsible for its social behavior; the computer is framed as a social actor). The pattern of LLH would result in a target (or in this case, tool) attribution (“I am aware that the social characteristics embedded in the computer were done so by a programmer and its socialness is not confusing; the computer is framed as a tool”). Finally, the combination of LLH will result in a circumstance attribution (“Being instinctively social, I react to the social characteristics embedded in the computer by a programmer possibly with confusion; framing is more the result of core self-evaluations”).† Figure 3 contains a graphical illustration of these three information cue patterns.

Parallels can be seen between the set of conditions suggesting individual causality (i.e. tool attribution) and the perspective of LS regarding information technology. Viewed from outside the body of information technology industry professionals (those responsible for the creation and control of computing technologies) the locally simplex perspective is generally one of *low consensus*. People tend to act toward and interact with computing technologies in a myriad of ways that are often context dependent in their nature. Further, locally simplex views are based on the predictability of the computer in doing exactly what it has been programmed to do each and every time, thus *high*

† This last combination may represent those near the mean of the continuum of perspective or may suggest an individual in transition from a GC perspective to a more LS perspective.

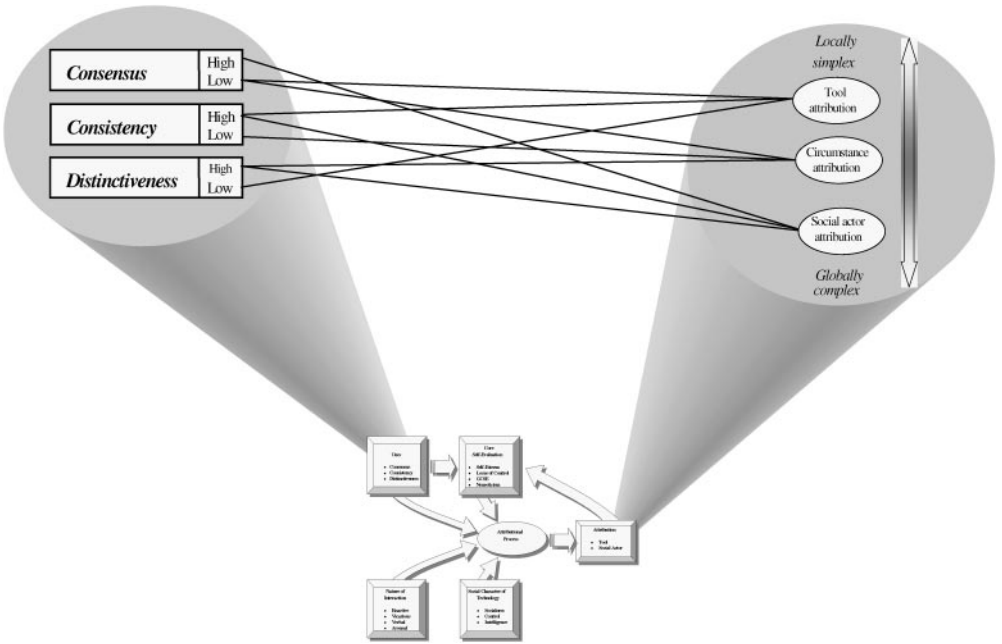


FIGURE 3. Model of attribution.

consistency. Finally, a locally simplex view suggests *low distinctiveness* since computing technology falls in the same perceptual category as any other technological tool or machinery. Further, a variety of instruction sets or methods exist to accomplish a particular task or reach a desired outcome with, and through, information technology (another example of low distinctiveness).

A converse explanation can be offered for the conditions suggesting external causality (i.e. social actor attribution) and the GC perspective. Within the globally complex grouping one can find a relatively *high consensus* regarding computers as seemingly intelligent social actors. Nass and Steuer (1993), for example, provide empirical evidence suggesting that given the proper set of cues people use social rules in interpreting the meaning of messages produced by computers and perceive the computers as independent sources for these messages. In addition, a great deal of ethnographic and anecdotal work suggests that individuals respond to IT based on social, rather than machine, behavior (Barley, 1986, 1988, 1990; Winograd & Flores, 1987; Zuboff, 1988; Scherz, Goldberg & Fund, 1990). By touching on the realm of rational intelligence previously reserved for human beings alone, the computer appears to fit comfortably with the consensual use of the anthropomorphic metaphor.

The omnipresent nature of information technology as a mediator for our daily relationships and as a surrogate for human interaction and intervention provides *high consistency* regarding the apparent reduced ability of the individual to control a situation in which the computer is an integral part. Finally, the *high distinctiveness* of computing technology from other technologies is enhanced since these individuals perceive their

interactions with computers to be unlike the interactions with any other mechanism or device. This is further reinforced by the similarities often experienced between situations mediated by computing technology and situations mediated by humans. In other words, the similarities to human interactions are often so strong in the computer's apparent myriad responses, applications and bearing in situations previously reserved for humans that these situations seem much different than those situations involving any other mechanical device or technology.

In summary, attribution theory is concerned with how individuals use information in their environment to construct reasons and causal explanations for both internal and external events. We posit that this theoretical lens gives us insight into the apparent misattribution of the computer as a social actor and may assist in our development of an understanding as to how it may be used in a positive sense and avoided in a negative one. We believe that each of the component elements in the model contributes independently toward the final attribution and its subsequent positive or negative consequences. It is proposed, therefore, that the nature of the interaction and the strong social cues emanating from information technology suggesting that IT is an autonomous source filtered through certain levels and combinations of core self-evaluations may encourage receivers in the globally complex group to forget, or ignore, the fact that the technology lacks motivation and attitude. It is at this point that the metaphor ceases to be a metaphor and the potential for becoming beguiled by its familiarity becomes very real.

It is at this point that we must turn our attention away from the first two objectives of the discourse, examination of the anthropomorphic metaphor and presentation of a theoretical model, to the exploration of the implications of the phenomenon to both the applied and academic communities. In preparation for this exploration, however, we must briefly consider the basic concepts and theory associated with the use of a metaphor as a descriptive device.

4. A metaphor justified

4.1. THE LITERAL AND THE METAPHORICAL

One of the major problems facing any theory of metaphor is that of how and where to draw the line between the "literal" and the "metaphorical". When we use an abstraction mechanism such as a metaphor to describe one object by another, we are demonstrating the pattern-matching activity that has been suggested as humanity's predominate methodology for decision-making (Simon, 1959). The problem with this explanation, however, is that our pattern-matching mechanisms seem to make only a lazy distinction between the symbol and that which is being symbolized (Gold, 1993). Admittedly, this lazy mechanism is what allows for the success of advertising, as well as art, literature, painting and even language. What it does not allow for, however, is a clear, reality-based understanding of the object being described. In fact, it could be argued that the use of a metaphor actually assumes a relatively clear understanding of the symbols being used and their intended relationships to the symbolized. While the use of metaphor does provide an opportune starting point for developing a clear understanding, at some point, however, it seems reasonable to argue that the descriptive metaphor must be replaced with direct reference to the object itself.

The very issue of the use of metaphor creates a controversy among social scientists (Pinder & Bourgeois, 1982, Bourgeois & Pinder, 1983; Morgan, 1983). Daft (1983), for example, suggests that the use of metaphor and analogy adds common sense to scientific descriptions:

... metaphor makes the strange familiar and it allows recognition and learning that links an idea to a previous experience. Metaphor and analogy provide a vehicle for relating new ideas to what is already known. Without this linkage the new idea has little value, little impact, and provides no means to elaborate on previous experience.

Conversely, in his discussion of the computational metaphor, MacCormac (1984) attempts to restrain the boundaries for metaphorical use by scientists:

... when a scientist resorts to metaphor, he is invoking a mushy, imprecise, figurative use of language; he should improve his theory to the point that he can present it in more precise terms...Any theory of metaphor that claims a distinction between the literal and the metaphorical will also have to explain how metaphors differ from everyday language, and how metaphors die and become part of ordinary discourse. Metaphors serve as catalysts for linguistic change; the metaphors of one generation become the banal expressions of another. (p. 213)

Fundamental to our understanding of the potential for both positive and negative effects associated with protracted use of both the machine-being metaphor, and the embedding of social characteristics into our computing technologies, is the need to consider a more basic issue: What makes computing technology seem so convenient to serve as our projection device? What is it that makes the computer appear to some as an autonomous entity that can act with agency? A number of observations can be made toward answering these questions.

Joerges (1989) argues that the energetic focus on information technology by both social and computer scientists has contributed somewhat to a collapse of the distinction between human beings and computers. In keeping with this premise, Turkle's (1984) work with children provides some evidence to suggest that the appearance of a blurred distinction between human beings and the computing machine may simply be the result of a fundamental hierarchical taxonomy of the world that is no longer adequate. We commonly attribute a relatively high level of consistency and predictability to machines and technology. The computer destroys this categorization by appearing proximally mechanistic while simultaneously appearing distally reactive and humanly unpredictable. The childhood hierarchical taxonomy of *stones-plants-animals-humans* built upon the pattern of *non-living-living-conscious-rational* suddenly becomes less descriptive for those members of the GC perspective who view the computer as conscious and rational. When apparently non-living objects like computers appear to regularly perform rationally, the question of where they should be placed in the taxonomy becomes a potential source of both cognitive dissonance and confusion. This confusion may further fuel the fires of the GC regarding a sense of loss of control over the situation or the presumable inability to act.

It is important to point out that the tendency of humans to anthropomorphize information technology does not necessarily reflect a lack of knowledge or the possession of naive beliefs regarding the "intelligence of machines". Information technology simply presents no clear correspondence with any other entities or objects in the world except for humans (Turkle, 1980). It is true that certain aspects of computer functions can be

reduced to more familiar activities that correspond to inanimate objects; e.g., describing an electronic mail system in terms of its similarity to the postal service or describing a database structure in terms of file cabinets, drawers and file folders.

Overall, however, the computer itself is irreducible. We can compile vast amounts of knowledge about it but we may never acquire enough understanding to describe the totality of the computer in terms of more familiar objects. It is this irreducibility that may encourage the protracted use of the anthropomorphic metaphor and may serve to exacerbate the difficulties faced by members of the GC perspective with regard to technological sense-making. In our attempt to reach a conclusion on a comfortable explanation of the computer, we naturally turn to the closest, most comfortable, model: ourselves. Sans humanity as a model, no necessary one-to-one relationships between the elements of the characteristic actions of the computer and other suitable substitutes can be easily found.

5. A metaphor personified

The importance of developing a better understanding of this pervasive social phenomenon can be readily seen in a wide variety of venues. Much evidence can be found in the academic literature to suggest that information technology is viewed as more than the object of neutrality and non-disruptive rationality suggested by the computer industry and the community of local simplexes (Balabanian, 1980; Ladd, 1989; Dunlop & Kling, 1991; Winter, 1993). Prasad (1993), in her study of the implementation of computing technology in a hospital setting, found that anthropomorphic behavior toward the technology was pervasive throughout the organization both before and after computerization.

It does your thinking for you when you are too tired ... Now it's become like a companion next to me everyday ... and doesn't talk back. Like I said, an ideal companion, (p. 1417)

Supervisors actively propagated the notion of the intelligent machine believing that this approach served to ease the implementation process through the creation of a favorable mental image of the computer:

“You need to learn respect for the computer ... this machine is probably smarter than you ... Be careful ... when you hit it [the keyboard] it sends an instant message to its brain,” (p. 1419).

Prasad reported that the human imagery seemed to reduce both the feeling of threat and overall anxiety and tended to promote almost an automatic trust of the device. She also reported, however, that the notion of intelligence promoted widespread disappointment when the system fell short of employee expectations. The computers began to “take the blame” for the negative outcomes.

Why do people respond socially to computers even when they are not consciously aware that they are doing so? One common explanation is that individuals who respond socially to computers are thought to have some sort of deficiency that prevents them from understanding how their application of social rules is inappropriate; that these individuals have some form of socio-emotional problems. This proposition becomes untenable when one considers that anthropomorphism has been applied to the mechanical realm since the industrial revolution and to the animal kingdom since the earliest

times. A more recent explanation is that humans are evolved to be social (Reeves & Nass, 1996). It is conceivable that humans are so emotionally, intellectually and physiologically biased toward responding in a social manner that when confronted with a minimal set of cues associated with social behavior, these deeply infused responses are automatically triggered (Moon & Nass, 1996).

Another explanation of the phenomenon may relate to the fact that our IT has often served as a projective screen for many social issues (Joerges, 1989). Turkle (1980) has extended this suggestion of the computer's capacity as a vehicle for projection by likening it to that of the Rorschach inkblots. In the Rorschach, perhaps the best known and most powerful of psychology's projective measures, how individuals respond to the inkblots is thought to be a window into their deeper concerns. The pervasiveness of computer-mediated relationships over the telephone, through our credit cards, when we travel or bank, buy groceries or borrow a library book, begins to challenge the traditional notions concerning privacy (Kling, 1980; Hirschheim, 1986), organizational status (Dawson & McLaughlin, 1986) and power (Markus, 1983). Turkle (1980) suggests that the metaphor may serve to create a "smokescreen" for the more deeply embedded societal issues and problems we inappropriately attribute to computers. It becomes easy to blame the computer for the atrophy of our skills, the constraints placed on us in a physical environment, the stresses we feel associated with our jobs or even the loss of our job. The metaphor of the machine-being allows us to comfortably project our fears and shortcomings onto the computer in an almost institutionalized fashion. A computer-mediated relationship is distinctly amoral and does not impose the same obligations of ethics and morality upon us that human-to-human relationships require. Information technology is seen as an autonomous entity (yet it can appear to act with agency) and so it becomes *culpable*; more so than even a co-worker to whom one might feel a certain bond of loyalty. The proverbial computer error serves as the primary example of this phenomenon. We tend to easily accept the attribution of a computer error to our billing or transaction problems. If, however, the computer could be removed from the scenario and was not available to serve as the attributed source of error, would we so easily accept the explanation that our billing difficulties are the result of an "electronic file cabinet error?" The metaphor may assist the GC perspective in forgetting that people are behind information technology and thus contribute to a sense of confusion and helplessness regarding what to do with it (or about it).

6. Implications

The final objective of this paper is to identify issues that may serve as the basis for both applied and academic inquiry into the use and application of the anthropomorphic model of computing technology and to the phenomenon of instinctive social interaction with the computer. To that end, we offer some observations with regard to both the positive and negative implications of its use.

6.1. POSITIVE IMPLICATIONS

Properly applied, anthropomorphism may provide opportunities to enhance human-computer interaction, to improve training and educational activities, and to extend the

computer's capabilities through the application of intelligent agents and avatars.† If the use of anthropomorphism in a particular situation can achieve the goal of decreasing our need to pay attention to navigating the system, it will certainly have a positive impact on human-computer interaction. Further, if its use enables the development and application of methods of interaction requiring less cognitive effort, it seems reasonable to assume that the user interface will become more transparent to the user thus allowing for more attention to be devoted to the task at hand. In this way, the neutral tool concept may become more of a reality.

The use of anthropomorphism in the design of intelligent agents has drawn heavily on anthropomorphic metaphors and appears to be a fruitful venue for their use. Intelligent agents have been characterized as personal digital assistants who can be trained, acquire information, take over human tasks and interact with people in ways that suggest humanness and intelligence (Maes, 1994; Bates, 1994; Norman, 1994). In fact, a major goal of these researchers is to enable these intelligent agents to work together, without human interference (Guha & Lenat, 1994). This suggests the creation of a virtual world, where intelligent agents inhabit space and interact on behalf of humans in very human ways. The proliferation of intelligent agents and the use of the anthropomorphic metaphor both serve to embed deeper into our culture the ideas of human-like intelligent and emotional machines with whom we interact.

Animated pedagogical agents that inhabit interactive learning environments can exhibit strikingly life-like behaviors (Lester, Converse, Kahler, Barlow, Stone & Bhoga, 1997). These agents may be able to play a powerful role in a wide variety of professional and educational settings. Because of their life-like behaviors, the prospect of introducing these agents, or avatars into educational or computer-based training software becomes intuitively appealing and appears to have a positive impact on both learning and learner satisfaction (Angehrn & Nabeth, 1997). By creating the illusion of life, the captivating presence of the agents could serve to motivate users to interact more frequently with agent-based educational software. These increased interactions have the potential to produce significant cumulative increases in the quality and effectiveness of an educational program over periods of months and years.

Another proposition regarding the positive implications of the anthropomorphic model is that the ascription of mental qualities and mental processes to the computer, under the proper circumstances, may serve the same purpose as it does when we do it to other people: it may help us to understand what they will do, how our actions will affect them, how to compare them with ourselves and conceivably how to design them. These increased levels of comfort and familiarity with the computer could provide positive benefits in both user productivity and the introduction of new software applications into a wide variety of social environments.

† In the Hindu religion, an avatar is an incarnation of a deity; hence, an embodiment or manifestation of an idea or greater reality. In three-dimensional or virtual reality games or chat worlds on the World Wide Web, your avatar is the visual "handle" or display appearance you use to represent yourself. Depending upon the complexity of the application and, thus, the selection of available avatars, one can choose to be represented by virtually any object or being ranging from a unicorn, to a human-form, to a robot or any kind of creature or object that seems right or is deemed desirable.

6.2. NEGATIVE IMPLICATIONS

It is important to understand that the argument here is not that the anthropomorphic metaphor should not or cannot be applied to developing an initial understanding of the computer. Instead, it is the protracted use of the machine-being metaphor as an analogic model that is being addressed by this side of the debate. Halasz and Moran (1982) have suggested that no ready analogy exists to completely describe a computer system (including an anthropomorphic one) and, as such, the use of a more conceptual or abstract model such as a mathematical or schematic model may be more appropriate to developing a useful understanding of the technology. It has been empirically demonstrated that novices tend to force an analogical model, such as the human-machine metaphor into a condition of *overmapping* (Sein & Bostrom, 1989). The overmapped analogy is carried beyond the intended boundaries of a literary metaphor meant to explain a single concept to its application as a tool for reasoning. The focus here, therefore, is on the problems that could evolve from the protracted extension of the metaphor into an over-mapped condition.

While the anthropomorphic metaphor is a useful mechanism for understanding the *similarities* between humans and computers, there exists the potential for it to mask the important *dissimilarities* between them. When the machine is not fully understood in its physical terms, rather only in anthropomorphic and metaphorical terms, the user is at risk of ascribing properties or characteristics to the computer that it does not truly possess. Within the social context of the workplace and our educational institutions, continued reinforcement of the metaphor may have negative consequences in the human-to-human interactions as the computer may take on social roles for which it was not intended. The opportunity for isolation, intercession and inappropriate intermediation pose threats to functional human interaction.

Shneiderman (1988) suggests that the anthropomorphic model of computers may suggest to certain individuals a degree of flexibility and range of capability that is deceptive. Further, he argues that the *machine à man* model may actually serve to cloud the development of a clear sense of humanity in children. This clouding may make it difficult for children to understand that relationships with people are different from relationships with computers. This misunderstanding could undercut their responsibility for mistakes (the proverbial “computer error”). We concur with Shneiderman’s suggestions regarding the replacement of the metaphor with more descriptive meaningful terminology and we extend his position to suggest that the misunderstandings suggested as outcomes of over-mapping the metaphor may manifest themselves in seemingly rational adults as well as children.

Our feelings about the IT can easily become formalized into ideologies about what the computer *can*, *will* or *should* be able to do (Turkle, 1980). Once these ideologies are formed, they may serve to decrease our sensitivity to the boundaries of application for our information technologies while equally blinding us to many of its positive social potentials. Continued application of the metaphor beyond this point may affect the way we think about ourselves by inducing an unconscious transfer between our ideas about computing technology and our ideas about people. These impacts may be particularly evident within the realm of decision making. While computers have been utilized effectively in highly structured decision-making environments (economic reorder points, automated replenishment, basic computational activities), the extension of the metaphor

to more complicated, less well-structured problems may lead to an inappropriate reliance on the computer, with an associated abdication of responsibility for the final decision.

Another area of possible negative implication for the metaphor may be related to the concept of user satisfaction with computing technology. This construct has occupied a central role in IS research for more than a decade and is often thought to be a surrogate for the success of an information system (Doll & Torkzadeh, 1988; DeLone & McLean, 1992; Melone, 1990). One of the suggestions as to the value of the development of human-like interfaces is that they make the system easier to use and should, therefore, increase the user's satisfaction with the system. Others, such as Shneiderman (1988, 1993, 1995), however, suggest that human-like interfaces may actually reduce satisfaction because they interfere with the processes which are occurring (i.e. they become a distraction).

Other research has found that while anthropomorphic interfaces may at times improve satisfaction with the system, they may not necessarily improve performance (Quintanar, Crowell & Pryos, 1982). Thus, the use of the anthropomorphic metaphor in the design of user interfaces may actually detract from the interaction experiences and may not provide the increased performance benefits which some suggest. Given the strong influence of core self-evaluations on the reaction to technology, we would expect that the use of human-like interfaces is likely to have differential effects on users, not the simple, and often overgeneralized, positive effects suggested by some.

The intention here is not to suggest that the anthropomorphic lexicon regarding computers is not useful in moderation. Rather, we suggest that without a clear understanding of the implication of its use, we cannot be sure of its effects, and it may serve as a barrier to clear thinking. The intense debate surrounding computers and our sense of individual right to control how information about us is used serves as a good example of this problem. It is easy to see that information technology facilitates the invasion of privacy of individuals through its capability to accumulate large volumes of data about them. This loss of privacy is not, however, always the result of carelessness or criminal abuse of IT but rather is often the result of our need to better define what our rights regarding privacy are. We feel we have such rights, but they have never been very well defined, largely because, before the advent of computer technology, there was very little need to define them; they just existed (Rothman & Mosmann, 1985).

All too often, however, the discussion of computers and privacy tend to end in a focus on the computer (Turkle, 1980). This focus easily draws our attention away from the fact that organizations and governments violated the privacy of individuals long before the emergence of information technology. We are drawn away from the fact that the problem lies not with our information technology, but rather with our social organization, political commitments and chosen quality of life. Forgetting that the being is *behind* the computer and not *within* it may contribute to a sense of helplessness and lack of choice within the GC perspective. The fact is we have a choice. If we want efficient crime prevention, modern conveniences, credit, transportation or other privileges, we are forced to give something of ourselves in exchange. It is this challenge upon which we must focus if we are to remove our barriers to understanding the relationship between information technology and social issues of privacy and ultimately, to better understand where the computer should sit in our taxonomy of all things.

6.3. IMPLICATIONS FOR ACADEMIC RESEARCH

The academic community must focus on pruning and refining the conceptual model proposed herein through empirical testing and validation. In this paper, we postulate the existence of a cognitive structure and processing procedure that affects the attribution of social characteristics to computers and we construct a comprehensive model that allows for empirical testing and behavioral prediction.

Further, we believe it is clear that the societal implications of such behavioral prediction are significant. For example, the development of a greater understanding of this phenomenon may allow us to focus on the derivation of answers to questions that speak directly to issues of performance and productivity. As an example, theories of social facilitation suggest that people attend more to the social aspects of a situation and may increase evaluation apprehension and task motivation in response to the presence of another person (Zajonc, 1965; Holroyd, Westbrook, Wolf & Badhorn, 1978). Given this, will employees work harder or more diligently in response to a face on the computer screen? Will strong social cues from a computing technology encourage the use of in-group/out-group decision rules? Could this cause an "us vs. them" attitude when interacting with a decision-support system that is designed to be perceived as social? Will computers with gender-specific voices encourage gender-specific stereotyping, as well?

An understanding of this phenomenon could also serve to inform the academic community directly. Answers to questions focused on the attainment of educational learning objectives may be more easily obtained and applied. Will children learn more from educational software if it is accompanied by a school teacher's persona?

Despite the ability to distinguish between the two attitudinal perspectives, it should be noted that the members of each group might have difficulty in either understanding or even acknowledging the existence of the other. Those who embrace a predominantly local perspective may actually find it unreasonable that any rational being could have any other view of the computer. Likewise, those who find the computer incomprehensible and possess a distinctly global view, may assume that others share that perspective (thus creating a false consensus) or may become even more frustrated by the LS perspective causing an "us vs. them" mentality. Here again, Heider's (1958) theory provides us with a possible explanation for this. Heider suggested that actors tend to attribute their own behavior to situational forces and therefore perceive it as high in consensus. This tendency to generate "false consensus" for one's own behavior has received empirical support in a number of studies (cf. Ross, Greene & House, 1977). In fact Ross *et al.* raised the possibility that actors' false consensus impression may be the cause rather than the effect of their situational attributions. Empirical investigation of this issue could provide a greater understanding of the pervasive tendency to resist the many changes associated with the conversion from manual to technology-facilitated processes.

Finally, the domain of social science and, more specifically, IT-related research may also be well served by an increased understanding of the role of social context in the realm of information technology. Which characteristics of computing technology encourage which individuals to use which social rules under which set of circumstances? Are there limits to the extent to which people make these social actor attributions? What is the shape of the generalization gradient when it comes to inferring mental states in computing technology, and if it is anything but flat, what characteristics seem conducive to making these inferences?

7. Concluding discussion

The universal approach to correction of the over-use of the anthropomorphic metaphor has been more computer education. Winograd and Flores (1987) suggest that lack of experience with computers serves as a source of anthropomorphism because individuals without experience lack an important basis for understanding how computer programs are created and used, leading to unreasonable expectations concerning the capabilities of the device. According to this perspective, novice users will be more likely to anthropomorphize computers than experienced computer users. This suggestion and its associated prescription, however, appears to be far too simplistic. Nass *et al.* (1995) empirically demonstrated that prior experience with computers, arguably the most conventional of predictors of attitudes toward computers, failed to inform any of the aspects of anthropomorphic behavior or social interaction. Information technology is arguably, like society itself, an abstract concept. Society is more than just people; it includes the interrelationships among them. Likewise, computing technology is not just about computers and processing of data. We must also consider the relationships among its uses and its users (Balabanian, 1980; Markus & Robey, 1988). While we may be addressing the need for computer literacy by providing the masses with basic skills and “the facts” about computers, we must not lose sight of the social construction of information technology and give equal effort to providing knowledge about the relationships between computers and people.

Our research is our way of “knowing” and from that effort we come to teach others. While our research literature provides a rich inventory of what we know about the relationships between IT and people, our academic texts provide virtually no acknowledgment. A recent study looking into the change in the content of our introductory information system texts over the last decade showed that human factors and social issues relating to IT are covered in less than one chapter and appear in less than 50% of the over 31 available texts currently available for adoption (Prattipati, 1993). Further, a review of MIS curricula at the doctoral level offered at universities throughout the United States suggests that the study of information technology is still primarily one of a technical nature and still at the early stages of a behavioral perspective. While a major field of research into human-computer interaction is firmly in place, some information systems literature suggests that this empirical work should be classified as “non-MIS” (Davis, 1989). The convenience of the *machine à man* metaphor allows the continued promotion of this paradigm.

The real desire is for the masses to favorably co-exist in an IT-rich society. While this appears to be within the skill domain of our social scientists, we must realize that they are constantly faced with deep-seated interpretive differences between the locally simple perspective and that of the globally complex. It will not, therefore, be so simple to educate people to view computing technology as purely a neutral tool. The computer, rather than being a tool through which we work, and thus disappearing from our conscious awareness, fails to get out of the way of our work and all too often remains the focus of our attention (Weiser, 1993). Turkle (1980) points out the need for reaching beyond the fundamental categorization of IT as a tool:

Of course the computer is a tool, but man has always been shaped by his artifacts. Man makes them but they in turn make him. In the case of the computer, however, we may

confront a tool that can catalyze a change in how we think about ourselves; for example, by making us aware on a daily basis of being only one among many other possible forms of “rule driven” intelligence. (p. 24)

Anthropological studies (Suchman, 1985; Lave, 1991) show us that people primarily work in a world of shared situations and unexamined technological skills. If we are to believe Kelley’s (1967) suggestion that attributions are applied in an effort to exercise control over a world view, then we can come to realize that the metaphoric characterizations of the future information technology as “intimate” (Kay, 1991) or “rather like a human assistant” (Tesler, 1991) only serve to perpetuate this focus on the machine instead of the work. The more the computer demonstrates measurable or observable effects within the environment or social context the more likely attributions of causality will be generalized across all computing technologies or IT-related tasks. Weiser (1993) suggests:

The challenge is to create a new kind of relationship of people to computers, one in which the computer would have to take the lead in becoming vastly better at getting out of the way, allowing people to just go about their lives. (p. 76)

The machine-being metaphor is widely used in society as a vehicle for managing the meanings of the attributions applied to the technological context. As a result, the metaphor has become firmly embedded in our society and the lexicon of the computing domain, is contributing to the consensus forming activities of our culture and, thus, should be subjected to empirical analysis if we are to better understand both the power and the desirable applications of it. McCloskey’s (1983) treatise on rhetoric in the literature and theories of classical economics argues that the best advice regarding the use of metaphor is to encourage self-consciousness about the metaphor. He suggests that an unexamined metaphor becomes a substitute for thinking.

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