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Toward a Positive Design Theory: Principles for Designing Motivating Information and Communication Technology

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Abstract

Due to the strategic, economic, and social significance of information and communication technology development and use, a better understanding of factors that contribute to technology acceptance and use decisions can be extremely important. In this chapter, we posit that one of the fundamental reasons that people utilize technology is to support their wellbeing by fulfilling their various needs. Taking this motivational perspective, we suggest that the purposes and utilities of information and communication technology should support various human needs. Using a motivational approach to study technology design is intended to be positive. We revisit some fundamentals that may have been forgotten and we unearth the intrinsic drive of technology development and use. As a first step toward a design theory, we propose ten design principles to achieve high motivating information and communication technology.

Keywords: Information and communication technology, motivation, design, theory, design principle

1 Introduction

Information and communication technologies are artifacts (Benbasat et al. 2003; Orlikowski et al. 2001). In this chapter, we use the terms information and communication technology, information technology, information systems, and technology interchangeably. Emphasizing the artifact aspect of information and communication technology provides an opportunity to examine it fundamentally and holistically. As a human-made thing, information and communication technology is, ideally, purposely envisioned to fulfill human needs and to support human values. Creation and design should then be guided by such understanding. Information and communication technology eventually should be used for its intended purpose. Such use should be within a certain context, and should affect humans and their surroundings. However, whether this use and impact match the envisioned needs and values is a question to be studied. This has implications for future design and practice with a new technology.

This process of envisioning, designing, creating, using, and causing various effects forms the lifecycle of the technology. Examining technology in terms of its whole lifecycle and its fundamental purpose is to study it from a holistic viewpoint, providing advantages that would not otherwise accrue. Very often, we see that the technology lifecycle is divided into parts that are disconnected from each other and from its fundamentals, and are being examined by scholars with different perspectives, in different disciplines. For example, we have seen situations where designers of a

technology, sometimes driven by innovations as incentives, have no idea or interest in its fundamental purposes, its potential acceptance and use by intended users, and its potential impacts on users and their surroundings. We have also seen social science studies on the use and impact of technology that focus primarily on technology as it has been used, not as it might be used (Malone 1985); and the results of such studies do not necessarily feed back to the next round of envisioning, design, and creation. The holistic view calls for collaboration and cross fertilization among all related parties. The emphasis is on how to design information and communication technology in such a way that they fit naturally into human lives and human organizations, and cause the desirable effects.

Taking this holistic lifecycle view of information and communication technology, we use a motivational perspective to reframe issues in technology design and use. This perspective is intended to approach information and communication technology design with a positive lens, by focusing on valuation of information and communication technology and a feed-forward attitude. It is to revisit some fundamentals that may be forgotten and to unearth the intrinsic drives of technology design and use. Questions such as "Why do people initiate, continue, stop, or avoid using information and communication technology?" "Why do technology use behaviors vary in intensity?" and "How can our understandings of these two questions help us design desirable technology that people really want to use?" naturally warrant a motivational perspective in investigations. Motivation theories explain human's various needs, the relationships among needs, psychological states, attribution, and environmental factors and their impact on goal-oriented commitments. Such understanding can contribute directly to various design tasks including, for example, instructional design (Small 1997; Small et al. 1998/1999) as well as information and communication technology design. Specifically, we discuss such understanding's role as contribution to technology design via the guidance of a design theory.

To take a motivational perspective on technology design and use is to take a human-agency perspective: transformations of organizational practice are enacted in technology use by individual users (Boudreau et al. 2005; Orlikowski 2000). Organizations invest a great deal of capital in information and communication technology, hoping for improved employee productivity, increased strategic advantages, and a competitive edge. Development firms and other stakeholders have increasing investments in new technology, hoping they will attract potential consumers during their trials with the technology and trusting that consumers eventually will decide to purchase and use it. Although continually evolving, technology does not determine its own trajectory of development and use. It is the individual users who create and innovate, and bring the values of technology to life.

An information and communication technology design theory is intended to inform and to guide design. Two decades ago, Malone argued that unlike explanatory theories ("Y because of X") and predictive theories ("If X, then Y"), design theories emphasize how to achieve goals ("In order to achieve Y, do X") (Malone 1985). Malone continued to say that design theories may include (1) techniques for clarifying goals to be achieved by the systems, (2) taxonomies of actions that might help achieve goals , and (3) guidelines for selecting actions (Malone 1985).

A design theory can take one or several perspectives. For example, Malone listed four perspectives for design-oriented theories for organizational interfaces: information processing perspective, motivational perspective, economic perspective, and political perspective (Malone 1985). In this paper, we would like to advance to design theories from a motivational perspective. We believe that this is complex enough to deserve a careful examination for its own sake. Design theories with multiple perspectives can be built on our understanding of single perspective theories.

In this paper we focus our attention on developing a set of design principles. Design principles are high-level and largely context-free design goals (Te'eni et al. 2007). Principles are more fundamental, widely applicable, and enduring (Shneiderman et al. 2005). Design guidelines, on the

other hand, are narrowly focused (Shneiderman et al. 2005), specific and context-dependent rules for designers to follow (Te'eni et al. 2007). Design principles are primarily derived from theoretical understandings of humans and their interactions with environments but also based on design experiences and practices, thus design principles are also called heuristics (Nielsen 1993; Nielsen 2000; Shneiderman et al. 2005). By focusing on design principles from a motivational perspective, our work is one step closer to a motivational design theory.

The rest of the paper is organized as follows. We first summarize the findings in modern motivational studies in areas that are pertinent to technology design and use behaviors (Section 2). In Section 3, we develop a set of design principles based on our understanding of motivation and existing technology design practices and technology use behavior studies. Our discussions connect to some of the most recent information and communication technology design efforts, such as aesthetics, emotional design, personalization, and user experience design. Our work can also tie early design efforts (such as user-centered design and usability) into a general motivational framework, although our main focus in this paper will be on framing design principles from a motivational perspective. Section 4 provides future directions for a motivational design theory and design practice. We hope that this paper inspires researchers and practitioners to continue the investigation of a motivational approach in designing human-centric technology artifacts that people want to use because they have the ability to support and improve users' performance and well-being, and thus their lives.

2 Understanding Motivation

In this section, we start with the concept of motivation and its role in behavior. We introduce several important motivational concepts, along with a framework of motivational sources. We discuss the relevance of using a motivational perspective to study technology design. This section provides a base for further discussions in Section 3, where design principles are developed.

2.1 Motivation, behavior, and motivation sources

The concept of motivation has been defined in many ways in the literature. The Oxford English Dictionary (2005) defines motivation as "the conscious or unconscious stimulus for action toward a desired goal, especially as resulting from psychological or social factors". This definition identifies two important motivational influences: psychological factors and social factors.

Modern motivation studies attempt to answer two questions: what causes behavior? and why does behavior vary in its intensity (Reeve 2005)? A theory of motivation explains why people do what they do; it explains the processes that give behavior its energy (behavior strength) and direction (behavior purpose). Energy implies that behavior has strength – that it is relatively strong, intense, and persistent. Direction implies that behavior has purpose – that it is aimed or guided toward achieving some particular goal or outcome (Reeve 2005) or avoiding some particular situations (Higgins 1998).

Modern motivation studies suggest that a person and his/her environment influence each other, thus forming a person-environment dialectic, and both person and environment constantly change (Deci et al. 1985; Higgins 1997; Higgins 1998; Reeve et al. 2003). In the dialectic, the environment places demands on the person to adjust and accommodate to it; the person acts on the environment out of an intrinsic motivation to seek out and affect changes in it (Deci et al. 1985).

There are many motivation theories developed in different disciplines, in different contexts, and from different philosophical points of views. For example, Reeve listed 24 motivation theories (Reeve 2005) that he refers to as mini-theories that dominate modern motivational studies. Motivation theorists suggest different types of motivations as well as different processes of motivation. For example, motivations can be intrinsic and extrinsic (Deci 1975; Deci et al. 1985; Ryan et al. 2000), or approach and avoidance (Elliot et al. 1997; Elliot et al. 2002), to name a few. Overall, motivation

theories focus on the sources of motivation and roles of motivation in behavior. This understanding of motivation sources and roles in behavior will be used in our study of a design theory of information and communication technology, to be detailed in Section 3. Here we give a brief summary of the motivational sources and roles in behavior.

The sources of motivation can be clustered into internal motives and external events (Reeve 2005). A motive is an internal process that energizes and directs behavior. There are three specific types: needs, cognitions, and emotions. Needs are conditions within the individual that are essential and necessary for the maintenance of life and for the nurturance of growth and well-being. Needs serve the organism, and they do so by generating wants, desires, and strivings that motivate whatever behaviors are necessary for the maintenance of life and the promotion of well-being and growth. There are three types of needs: physiological, psychological, and social needs.

Physiological needs are inherent within the workings of biological systems. Such a need implies a deficient biological condition. If neglected, bodily harm or pathology follows.

Psychological needs are inherent within the strivings of human nature and healthy development. They arise from the self's requirement and desire to seek out interactions with the environment, creating practices that promote psychological vitality, well-being and growth. Examples of psychological needs include autonomy, competence and relatedness.

A social need is an acquired psychological process that grows out of one's socialization history that activates emotional responses to a need-relevant incentive. Social needs are thus internalized or learned from our emotional and socialization histories. Achievement, affiliation, intimacy, and power are examples of social needs.

Internal motives also include cognitions and emotions. Cognitions refer to mental events, such as beliefs, expectations, and the self-concept. Cognitive sources of motivation revolve around the person's ways of thinking. Emotions are short-lived, subjective-physiological-functional-expressive phenomena that orchestrate how we react adaptively to the important events in our lives.

External events are environmental incentives that have the capacity to energize and direct behavior. Incentives precede behavior and functionally pull the person closer to external events that promise pleasant experiences or functionally push the person away from external events that promise unpleasant experiences. External events can include broader forces such as social contexts and culture.

To focus this paper, we develop design principles that draw on the following motivational sources: psychological, social, cognitive and emotional. Physiological needs are closely related to physical and biological aspects of humans; external events as motivational sources deserve a good look in their own right. We acknowledge the importance of studying both physiological and external sources, but we leave them outside the scope of this study.

2.2 A motivational perspective on information and communication technology design

Due to the strategic, economic, and social impacts of technology development and use, understanding what contributes to an individual's technology acceptance and use behaviors becomes one of the most important research topics in the contemporary information systems discipline, as well as in other related social sciences disciplines. It is obvious that with the correct understanding, technology development firms can be informed to utilize their resources accordingly to emphasize the aspects of technology that would attract and sustain consumers. Organizations can invest in technology effectively to ensure their employee productivity and increased competitive

edge, and can be sure to attract and hold their consumers or clients to their businesses via technology use.

It is crucial that we understand technology use behavior and eventually feed this understanding into technology design. This naturally calls for a motivational approach because motivation explains what gives behavior its energy and direction. Technology is an object in the environment that people interact with. Taking a motivational perspective has the benefit of applying our understanding of the person-environment dialectic to technology use behaviors, thus leading us to focus on designing technology so that it fits naturally with people and their surroundings and thus has the desired impacts on people, organizations, and societies.

Using a motivational approach is also in line with the recent strand in organizational theorizing and management research on being positive. Positiveness focuses on understanding the "best" of the human condition, "positive deviance," and "spirals of flourishing" (Fineman 2006). It draws on a number of different developments, such as appreciative inquiry (Cooperrider et al. 1987) and prosocial behavior, but especially positive psychology and its organizational psychology offshoot, positive organizational scholarship (Fineman 2006). The main idea is to shift from focusing on what is negative and problematic to focusing on what is good and positive – the finest of individual experiences, intentions, and outcomes (Fineman 2006). The ultimate goal of drawing on positive scholarship is to create a better world characterized by equity, integrity, truth, inclusion, and fulfillment (Roberts 2006). Positive scholarship is an umbrella term that categorizes previous research and provides an organizing frame for current and future research on positive states, outcomes, and generative mechanisms in individuals, dyads, groups, organizations, and societies (Roberts 2006). From this perspective, a motivational approach to study technology design can be considered part of positive scholarship, because positive states, outcomes, and generative mechanisms are the targets of research on design principles. Specific design principles derived from motivation theories can be considered generative mechanisms of positive states and outcomes. That is, with the positiveness philosophy in mind, the design principles support human success and well-being, positive states, and the best conditions one can be, among others.

A motivational approach can be highly promising. In Section 3, we demonstrate this by reframing some of the innovative technology design approaches. Here we briefly present some ideas and existing work that have a motivational focus. For example, given that all humans have certain needs, technology designers and managers should keep in mind that such needs exist and can be met when people interact with technologies. Applying motivation theories to information and communication technology design and management then involves identifying various ways to facilitate the fulfillment of needs. One application of Herzberg's two factor theory (Herzberg 1966; Herzberg 1968, a need theory of motivation) to the web environment suggests that individuals connect their various needs to the web environment (Zhang et al. 2000). Understanding the social influences in motivation can be very helpful in studying human interactions with information and communication technology in a social context. For example, Deci and Ryan's self-determination theory (Deci 1975; Deci et al. 1985; Ryan et al. 2000) has been used in studies of knowledge sharing communities (Kwok et al. 2003), and open source workers' satisfaction in a virtual community (Chin et al. 2004), among others.

3 Information and communication technology Design Principles

3.1 Technology related behaviors and environmental factors

Technology is part of the environment that is outside a person. The person-environment dialectic posits that the environment places demands or opportunities on the person, and the person acts on the environment. Designing information and communication technology with a positive lens and a feed-forward attitude is thus about applying our understanding of information and communication

technology related behavior (the second half of the information and communication technology lifecycle) and designing technology (the first half of the lifecycle) for the desired or intended technology behavior.

Technology related behaviors. Behaviors can be approach oriented or avoidance oriented. Examples of technology related approaching behaviors might be a user personalizing the appearance of PCs and mobile phones (Blom et al. 2003); a consumer downloading mobile phone ring tones from a commercial website (Tam et al. 2005); a person reading news from CNN.com (Zhang et al. 2000; Zhang et al. 1999) or seeking information on other types of websites (Zhang et al. 2001-2002); a user playing a computer game; people using instant messaging to keep in touch with friends and families; a class utilizing a course management system such as WebCT or Blackboard in their online discussions of a topic or course project (Heckman et al. 2005); programmers using information and communication technology for their open source development project; a person conducting his/her normal daily behaviors in an ubiquitous computing environment where information and communication technology is invisible, and so on. Avoidance behaviors related to information and communication technology can be those opposite the above. For example, employees of an organization avoiding or refusing to use an Enterprise Resource Planning (ERP) system for their jobs; students avoiding or refusing to use WebCT or Blackboard for course related discussions; people avoiding using instant messaging on the Internet or text messaging via mobile phones, among others. These approaching and avoiding behaviors may or may not be desirable. A motivational approach to study these behaviors serves to unearth their motivational drives, the reasons these behaviors are undertaken.

Environmental factors. The user's environment includes technology with associated features and capabilities, as well as relationship/sociocultural influences. The person-environment dialectic view of motivation posits that the environment and the person influence each other and both determine motivation and behavior. The components of the environment can have certain qualities and capabilities to make them motivationally significant, that is, to provide feasibility to fulfill a motivational need. This is where the motivational approach to design attempts to focus. Since our goal is to design motivational information and communication technology, we will now narrow our attention to information and communication technology but keep the other aspects of the environment within a holistic picture of the motivational approach. Emphasizing the other aspects of the environment can lead to many other interesting studies (such as management interventions of technology design and use) that are beyond the scope of this paper.

3.2 Design Principles

Motivational theories, as well as evidence from current information and communication technology design practice and use behavior studies must be translated into design principles that formalize high-level and widely applicable design goals (Te'eni et al. 2007). Design principles influence design practice by providing high level guidance on the What and Why, but not the How questions of design. That is, design principles remind designers what issues may exist and why so. But design principles leave the designers to choose how to implement the principles. These decisions can be influenced by task factors, context factors and technology platforms, and so forth.

The overarching goal of the design principles proposed in this paper is to positively support people's motivational needs. Yet information and communication technology designs are dependent on users, tasks, and use context (Te'eni et al. 2007). This means that the same design principles may not serve all technology design goals the same way. In other words, not all principles are of equal interest in designing a particular technology, and not all design principles should be implemented the same way. Designers need to choose what principles to emphasize for a particular technology design situation. For example, autonomy may be less desirable in one national culture than in another. This may put a spin on how to implement the design principle of supporting autonomy (see

below). It is beyond the scope of this paper to detail all situations and factors that may affect how the design principles proposed here can be applied. Later in Section 3.3, we outline a few situations where certain motivational design principles may work well.

The principles presented here are structured around the four motivational sources introduced in Section 2.1: psychological, social, cognitive, and emotional. Several motivational sources may be considered together when a particular principle is developed. As a first effort toward a motivational design theory, our goal is not to provide a comprehensive list of design principles but to demonstrate the rationale, feasibility and promise of such principles.

The design principles are summarized in Table 1, along with their primary theoretical support. These are discussed in detail in this section.

Table 1. Summary of design principles for achieving motivational information and communication technology

Motivational Needs	Design Principles	Primary Theoretical Base
Psychological: Autonomy and the self	Principle 1. Support autonomy. Principle 2. Promote creation and representation of the identity of the self.	Self-determination theory (Deci et al. 1985)
Cognitive: Competence and achievement	Principle 3. Design for optimal challenge. Principle 4. Provide timely and positive feedback.	Flow theory (Csikszentmihalyi 1975; Csikszentmihalyi 1990); Goal theories (Elliot et al. 1997)
Social, Psychological: Relatedness	Principle 5. Facilitate human-human interaction. Principle 6. Represent human social bond.	Social interaction studies (Baumeister et al. 1995)
Social, Psychological: Power, leadership and followership	Principle 7. Facilitate one's desire to influence others. Principle 8. Facilitate one's desire to be influenced by others.	Affect control theory (Heise 1985)
Emotional: emotion and affect	Principle 9. Induce positive emotions via information and communication technology surface features. Principle 10. Induce intended emotions via information and communication technology interaction features.	Affect and emotion studies (Russell 2003; Sun et al. 2006)

3.2.1 Autonomy and the self

Autonomy (or self-determination) is the psychological need to experience choice in the initiation and regulation of behavior; personal choices rather than environmental events determine one's action (Deci et al. 1985). When deciding what do to, we desire choice and decision making flexibility: we want to be the one who decides what, when and how to do it, when to stop doing it and whether or not to do it at all. Behavior is autonomous when our interests, preferences, and wants guide our decision making process to engage or not engage in a particular activity (Reeve 2005).

The self-determination theory hypothesizes that autonomy-supportive social contexts tend to facilitate self-determined motivation, healthy development, and optimal functioning (Deci et al. 1985). Other specific positive outcomes experienced from an autonomy-supporting style include development gains (greater perceived competence, higher self-esteem, and enhanced sense of self-worth), engagement gains (greater engagement, positive emotional tone, stronger perceptions of control, preference for optimal challenges, pleasure from optimal challenges), performance gains (improved performance, higher achievement), high quality learning (greater flexibility in thinking, enhanced conceptual learning, more active information processing, and greater creativity), and optimal functioning (maintenance of behavioral change, long-term retention) (Reeve 2005, p. 112).

If these positive outcomes are goals for information and communication technology use, then a motivating information and communication technology should have an autonomy-supporting style.

There are various ways for information and communication technology to involve, nurture, and support, or neglect and frustrate our need for autonomy, and such need can be at different abstract levels. For example, a restricted time frame for interacting with a technology at the operational level (e.g., finishing an information and communication technology related task within a certain time period) interferes with autonomy; opportunities or flexibility for self-direction at operational or conceptual levels support autonomy. Regardless of which ways or which levels, supporting autonomy should be an information and communication technology design principle.

Principle 1. Support autonomy.

The province of the self is to pursue the quality of one's psychological well-being. Motivational analysis of the self has three aspects: defining or creating the self, relating the self to society, and discovering and developing personal potentials (Reeve 2005). We will cover the last two aspects a little later. Here we focus on defining and creating the self, specifically self identity.

Defining and creating the self is an ongoing process. Being able to tell ourselves and others who we are is an important part of the process of self creation and definition. Information and communication technology, just as many other objects in one's environment, should support one's need for defining and representing the self. Identities function in a social context. Thus identities normally contain information about the particular individual, the immediate group, the social context, and the cultural context that the individual belongs to.

Principle 2. Promote creation and representation of self-identity

Many existing information and communication technology design efforts and behavior studies support the two principles presented here. Personalization is one such example. People personalize their environments and objects in their surroundings. Personalization of one's environment is "the deliberate decoration or modification of the environment" (Wells 2000). Personalization of technology is "a process that changes the functionality, interface, information content, or distinctiveness of a system to increase its personal relevance to an individual" (Blom 2000). We have witnessed personalization in cell phone covers/skins and ring tones, desktop skins, website portals (e.g., Yahoo.com allows one to set up her own preferred My Yahoo page), and the appearance and functionalities of many technologies people use. Heidmets concluded that personalization takes place primarily to control the environment by which the participant's own self is displayed in externalized form (1994, in Blom et al. 2003). People personalize their information and communication technology and other objects in their environment because it satisfies their need for autonomy and the need to represent one's self.

There are other examples of technology being designed to promote the creation and representation of the identity of the self. A teenager buying a digital camera solely because of its rare blue color (Te'eni et al. 2007) is a good example of the significance of technology features as a way of representing one's self-identity. Furthermore, people reevaluate their identities in the age of the Internet: we are using life on the screen to engage in new ways of thinking about evolution, relationships, politics, sex, and the self (Turkle 1995). In general, technology that has the ability to allow one to personalize its various aspects has high motivational affordance for the needs of autonomy and self-identity.

3.2.2 Competence and achievement

Competence is a psychological need, and achievement is a learned social need. They are closely related, thus we discuss them together when presenting information and communication technology design principles.

Everyone wants and strives to become competent. Competence as a psychological need provides an inherent source of motivation for seeking out and putting forth the effort necessary to master optimal challenges that are developmentally appropriate (Deci et al. 1985; Reeve 2005, p. 115). When we engage in a task with a level of difficulty and complexity that is precisely right for our current skills, we feel the strongest interest and the greatest involvement of the need for competence. The situations we are in can satisfy our need for competence, or they can neglect and frustrate this need. One key condition that involves competence need is optimal challenge, and one key condition that satisfies our competence need is positive feedback (Reeve 2005).

Csikszentmihalyi's flow theory (Csikszentmihalyi 1975; Csikszentmihalyi 1990) is influential in studying competence, enjoyment, optimal challenge and optimal experience. Flow represents a state of consciousness where a person is so absorbed in an activity that they excel in their performance without consciously being aware of their every movement (Finneran et al. 2005). It occurs when a person uses her skills to overcome some challenges. Flow occurs when the challenge-skill balance falls into the "flow channel." Too much challenge causes anxiety and worry, and too little challenge (thus too much skill) cause boredom.

Optimal challenge, represented by a level of difficulty and complexity, is related to goals one may set or be assigned. Each person may have different levels of skills, thus would require different levels of challenges. For an information and communication technology to support all possible targeted users, identifying and setting different challenge levels are central to implementing this principle in design.

Related to the different types of standards of excellence are two goals: mastery goals and performance goals. Mastery goals generally cultivate a self-based (or task-based) evaluation of one's competence, and these goals focus the performer's attention on developing competence and mastering the tasks. Thus achieving a mastery goal means making progress. Performance goals generally cultivate a norm-based evaluation of one's competence, and these goals focus the performer's attention on the demonstration of ability relative to that of others (Reeve 2005). Performance goals can be further examined as performance approach goals (emanate from a person's need for achievement) and performance avoidance goals (emanate from a person's fear of failure) (Elliot et al. 1997). The adoption of mastery goals and performance approach goals is associated with positive and productive ways of thinking, feeling, and behaving; whereas the adoption of performance avoidance goals is associated with relatively negative and unproductive ways of thinking, feeling, and behaving. For example, empirical studies show that even for elementary school students, those who adopted mastery goals (improving, learning), compared to those with performance goals (high grades), were attracted to challenge rather than threatened by it, and enjoyed the class more (Ames et al. 1988).

Challenge has been suggested as a design principle for designing enjoyable user interfaces. Malone suggested promoting challenge by (1) presenting clear goals in the activity, (2) providing performance feedback about how close a user is to achieving the goal, and (3) providing uncertain outcomes in reaching the goal (mainly by providing variable levels of difficulty and multiple goals) (Malone 1981a; Malone 1981b). The following principle is proposed for optimal challenge in order to support competence:

Principle 3. Design for optimal challenge.

Achievement is a learned social need. It is one's desire to do well relative to a standard of excellence (McClelland et al. 1953). The standard of excellence is a broad term that encompasses (1) competitions with a task (solving a puzzle, writing an essay), (2) competitions with the self (improving one's GPA, running a race in a personal best time), and (3) competitions against others (winning a competition) (Heckhausen 1967). A person encounters a standard of excellence and is energized by it because s/he knows that the forthcoming performance will produce an emotionally

meaningful evaluation of personal competence (Reeve 2005). When facing standards of excellence, people's emotional reactions vary, as do their behavioral responses, depending on their levels of achievement need. Standards of excellence therefore offer people two-edge swords: sometimes they excite us and we react with approach emotion and behavior; other times, they bring us anxiety and we react with avoidance emotion and behavior (Reeve 2005).

Individuals need to perceive or evaluate their performance toward goals. Feedback provides support for this evaluation. Related to the standard of excellence above, feedback can come from a number of sources: the task itself, comparisons with one's own past performance, comparisons with others' performance, evaluations given by others, or some published standard. "Timely" response is essential so that the "flow" of cognition and action does not break. "Positive" means to focus on the informational aspect of feedback (how far it is from achieving the goal) rather than on criticism of behavior. The combination of goals/challenge and feedback produces an emotionally meaningful mixture: goal attainment breeds emotional satisfaction, while goal failure breeds emotional dissatisfaction. Thus the following depicts the feedback principle.

Principle 4. Provide timely and positive feedback.

The two principles are closely related to each other in that one is about setting the goal, the other on providing feedback about achieving the goal. Moderately difficult tasks have the potential to involve and satisfy the need for achievement (McClelland 1985). Principle 3 above, design for optimal challenge, supports setting the goals that match one's skills, and thus can involve and satisfy one's achievement need. Principle 4, provide timely and positive feedback, is essential for checking on one's progress (mastery goals) as well as performance goals. Thus it also supports one's achievement need.

3.2.3 Relatedness

Relatedness is a psychological need indicating the innate desire to belong: everyone needs to belong; everyone desires social interaction. Relatedness is the need to establish close emotional bonds and attachments with other people, and it reflects the desire to be emotionally connected to and interpersonally involved in warm relationships (Baumeister et al. 1995). Interaction with others is the primary condition that involves the relatedness need; perception of a social bond then satisfies the relatedness need (Reeve 2005). Technology designers should consider facilitating relatedness as much as possible. Providing human-human interaction mechanisms via technology (thus computer mediated human-human interaction), and providing ways of displaying the social bond are essential to provide this motivational affordance. Thus we have the following principles.

Principle 5. Facilitate human-human interaction.

Principle 6. Represent human social bonds.

Many current information and communication technology designs support this principle to some extent. For example, besides information and communication technologies that are directly designed to support relatedness (e.g., instant messaging), technologies that have the function of supporting this need become more attractive and more frequently used (e.g., games that have a chat window/area). Supporting users' need for relatedness and affiliation has been considered in group support systems (Ocker 2002). Studies in the IS literature show that information and communication technology design should consider not only how people communicate, but also what they communicate. Te'eni, for example, presented a balanced cognitive-affective model of organizational communication where supporting people's relatedness need and social bonds is as important as supporting people's task/action performance in organizational settings (Te'eni 2001). In a recent effort, an email interface is designed to visualize the intimacy and chronology of one's social

connectedness over time (Mandic et al. 2005). This is one example of supporting the human need for relatedness by representing human social bonds (Principle 6). The research effort on social presence in the computer mediated environment (McLellan 1999; Sproull et al. 1986) is also related to Principles 5 and 6.

3.2.4 Power, leadership and followership

Power is another learned social need. Its essence is a desire to make the physical and social world conform to one's personal image or plan for it (Winter et al. 1978). A person's need for power can be determined by two factors: one is personality ("born with it"), the other is social situations ("social role or identity").

People high in the need for power desire to have impact, control or influence over another person, group or the world at large (Winter 1973). Power strivings often center on a need for dominance, reputation, status, or position. High-need-for-power individuals seek to become (and stay) leaders. Leadership thus is a condition that involves and satisfies the need for power (Reeve 2005). The essence of being a leader and feeling powerful is the influence and impact one has over others and over the environment. Very often, we also experience the desire to follow (even for those who have a strong need for power). We seek, admire, and respect those who lead us by providing us certain emotional feelings (Goffee et al. 2001).

The leading and following desires are not mutually exclusive: the same person may want to lead in certain situations and follow in other situations. This can be explained by the affect control theory (Heise 1985). According to this theory, people act differently from one situation to the next because they inhabit different identities that can be offered by social and cultural groups and contexts. A multitude of possible identifies one is likely to inhabit can be represented numerically along three dimensions: level of goodness, level of powerfulness, and level of liveliness.

A good information and communication technology design should realize both leadership and followership needs and thus incorporate the following principles.

Principle 7. Facilitate one's desire to influence others.

Principle 8. Facilitate one's desire to be influenced by others.

Information and communication technology as a computer mediated environment (CME), just as the traditional environments, should allow people with various levels of need-for-power to strive. There are leaders and followers, and different leaderships and leadership patterns may have different impacts on group performance (Heckman et al. 2005) and social bonds. These two principles can play important roles in collaborative information and communication technology design and several other types of information and communication technology design. One example is blog. Among several factors that contribute to the broad success and wide acceptance of blog technology is that blogging satisfies one's desire to influence others (by posting, expressing opinions), as well as one's desire to be influenced (by quietly reading and following others' postings). Leadership is made possible only when there is followership. Thus in a way, these two principles have to work together.

3.2.5 Emotion and affect

Affect is a general word for several related but different concepts and normally represents mood, emotion, and feeling (Russell 2003). Studies in organizational behavior, marketing, and management have confirmed the strong impact of affect on job satisfaction, decision-making behavior, and consumer shopping behavior (Sun et al. 2006; Zhang et al. 2005).

Emotions are induced affective states (Russell 2003). They typically arise as reactions to important situational events (Reeve 2005) and objects in one's environment. Once activated, they generate feelings, arouse the body into action, generate motivational state, and express themselves publicly. Thus, emotions are more than just feelings, and have four components: subjective, biological, purposive, and social phenomena (Izard 1993). The subjective component is about the particular feelings we have (angry or joyful). The biological component is about the energy-mobilizing responses that prepare the body for adapting to whatever situation one faces. Emotions are also agents of purpose. Anger creates a motivational desire to do what we might not otherwise do. Finally, emotions are social phenomena that communicate (via facial, postural, vocal signals etc.) the quality and intensity of our emotionality to others.

Emotion is related to motivation in two ways. First, emotions are one type of motive (other types are needs and cognitions) that energize and direct behavior. Anger mobilizes subjective, physiological, hormonal, and muscular resources (i.e. energize behavior) to achieve a particular goal or purpose (i.e., direct behavior) such as overcoming an obstacle. Second, emotions serve as an ongoing "readout" system to indicate how well or how poorly personal adaptation is going. Joy signals social inclusions and progress toward our goals, where as distress signals social exclusion and failure. Emotion is motivation and appears in all motivational processes (Reeve 2005). Therefore, the early discussions of motivations and several principles touch upon emotions constantly. That is, in a way, all motivational discussions so far touch upon emotions.

Due to the importance of emotions in motivation and behavior, we examine additional aspects related to emotions that can guide the development of information and communication technology design principles. This also happens to be an area that many recent information and communication technology design efforts focus on, such as emotional design (Norman 2002; Norman 2004), aesthetics, presence, and beauty in design (Frohlich 2004; Hallnas et al. 2002; Tractinsky 2006; Tractinsky et al. 2000), affective quality (Zhang et al. 2004; Zhang et al. 2005), funology (Blythe et al. 2005; Hassenzahl et al. 2001; Monk et al. 2002), and user experience (Hassenzahl et al. 2006), among others.

Historically there are two views of what causes an emotion. The cognitive primacy hypothesis states that appraisal of meaning causes emotion: is the event relevant to well-being? important? harmful? beneficial? Once the meaning is established, then emotion follows accordingly (Lazarus 1982; Lazarus 1984). The biology primacy hypothesis posits that emotional reactions do not necessarily require such cognitive evaluations (Zajonc 1980; Zajonc 1984; Zajonc et al. 1982), as demonstrated by the empirical evidence of human infancy (Izard 1984; Izard 1989), automatic/involuntary emotions (Ekman 1992), and brain circuits (Panksepp 1982). Modern emotion studies combine the two views and propose that human beings have two synchronous systems that activate and regulate emotion. The primitive biological system is an innate, spontaneous, physiological system that reacts involuntarily to emotional stimuli. The contemporary cognitive system is an experience-based system that reacts interpretatively and socially. Combined they provide a highly adaptive emotion mechanism (Buck 1984). Further studies indicate that the two systems do not merely parallel but also influence each other (Levenson 1994).

The key for applying emotional studies to information and communication technology design is thus two-fold: induce intended emotions based on the biological system where no cognitive processing occurs, and induce intended emotions via the cognitive system that is interpretive and reflective in nature.

Certain aspects or qualities of information and communication technology will generate automatic/involuntary emotions without cognitive processing. These aspects and qualities are most likely to be "on the surface" such as appearance and immediate audio signals. Principle 9 addresses this situation.

Principle 9. Induce intended emotions via information and communication technology surface features.

The cognition primacy hypothesis suggests the formation of certain emotions based on interpretation and reflection. There has to be a process or duration of interaction between a person and technology for this formation to occur. This means that the interaction process a person has with information and communication technology is critical in generating intended emotions. This leads to the next principle.

Principle 10. Induce intended emotions via information and communication technology interaction features.

information and communication technology designs that emphasize the appearance, first impression, and primary emotions all support this principle. Empirical evidence shows that a half second exposure to an information and communication technology would be sufficient to generate certain emotions (Lindgaard et al. 2006). Studies of hedonic quality (Hassenzahl 2001; Mundorf et al. 1993), perceived aesthetics (Tractinsky et al. 2000), perceived visual attractiveness (van der Heijden 2003), perceived affective quality (Zhang et al. 2004; Zhang et al. 2005; Zhang et al. 2006), and attributes of skins (Tractinsky et al. in press) are all related to this principle.

Efforts toward identifying specific information and communication technology design factors are on the way toward further supporting and implementing this principle. Kim and colleagues classified the specific emotional dimensions users normally experience while viewing diverse homepages; they identified the design factors that professional designers frequently use when developing emotionally evocative homepages; and they empirically confirmed that the identified emotional dimensions can be reliably explained by the selected design factors (Kim et al. 2003). Lavie and Tractinsky, in developing a measurement instrument of perceived Web site aesthetics, identify two dimensions of user aesthetic perception. The classical aesthetics dimension emphasizes orderly and clear design and is closely related to many of the design rules advocated by usability experts. The expressive aesthetics dimension is manifested by designers' creativity and originality and by the ability to break design conventions (Lavie et al. 2004).

Information and communication technology designs that emphasize the interaction process are examples that support this principle. Flow experience (discussed earlier) is one typical example where the intended positive emotions occur(Finneran et al. 2002; Finneran et al. 2005; Ghani 1995; Webster et al. 1993). Similar concepts that are studied in the literature include cognitive absorption (Agarwal et al. 2000; Zhang et al. 2006), computer playfulness (Bozionelos et al. 1997; Hackbarth et al. 2003; Webster 1989; Webster et al. 1992; Yager et al. 1997), and computer enjoyment (Sun et al. 2005; Yi et al. 2003), among others. Sometimes, negative emotions may be desirable, and thus may be the intended emotions designers want to induce via information and communication technology interaction. For example, anxiety is negative. But anxiety can be motivational in achieving certain goals. Inducing anxiety during interaction can be accomplished by designing certain information and communication technology interaction features.

3.3 Applications of Motivational Design Principles

As we mentioned briefly, not all design principles are of equal interest in particular information and communication technology design situations, and not all design principles should be applied the same way. It is well acknowledged that certain design principles can support conflicting goals (Te'eni et al. 2007).

The applicability of principles for any given situation depends on the goals of each particular information and communication technology and the corresponding human needs that may arise in

that situation. For example, an information and communication technology can have a primary goal of community building, problem-solving, skill acquisition, and knowledge dissemination, to name a few. There may be secondary goals or by-products the designers have in mind for each technology use situation. Under each goal, different human needs may arise; some of them may be desirable and thus should be supported, while others may be undesirable and thus should be discouraged.

It is very often the case that one may find several design principles at work in one particular information and communication technology use situation. For example, one typical example that involves autonomy, competence, mastery achievement need, and emotional satisfaction is a flow experience. Possessing a clear innate goal that is appropriate to one's skills and having a sense of autonomy for achieving the goal are preconditions for flow to occur (Principles 1 and 3). Informational and timely feedback is critical for flow experience to occur and continue (Principle 4). Flow theory is used to address optimal user experiences with personal computers (Ghani 1995; Ghani et al. 1994; Trevino et al. 1992; Webster et al. 1993), the World Wide Web (Chen 2000; Chen et al. 1999; Hoffman et al. 1996; Nel et al. 1999; Novak et al. 2000; Pace 2004), online shopping (Koufaris 2002), and online gaming (Hsu et al. 2004), to name a few. Within a computer-mediated environment, the experience of flow is shown to lead to increased communication (Trevino et al. 1992), exploratory behavior (Ghani 1995; Ghani et al. 1994; Webster et al. 1993), learning (Ghani 1995), positive affect (Chen 2000; Trevino et al. 1992), and computer use (Ghani et al. 1994; Trevino et al. 1992; Webster et al. 1993).

For a particular situation, a principle may belong to the "should apply," "should not apply," or "may help if applied" category. For example, in a collaborative environment where there is a clearly defined task that needs to yield concrete results by the end of the information and communication technology use session, the needs for human-human interaction, leadership and followership may exceed the needs for autonomy and optimal challenge. In fact, in this situation, autonomy may be counter productive, and thus may need to be discouraged. Correspondingly, for this situation, Principles 5, 7, and 8 should apply, Principles 1 and 3 should not be applied, while Principles 2, 6, and 9 may help if they are applied. In another situation where a user is encouraged to explore a task space to develop certain skills, the needs for autonomy, optimal challenge, timely and positive feedback, and positive emotion should be supported by applying Principles 1, 3, 4, and 9. Yet in another situation where a technology is to be a portable personal assistant, the needs for identity, human-human interaction, social bond, and positive emotion should be supported by applying the corresponding principles, 2, 5, 6, and 9.

User behavioral studies can provide robust understanding about what needs may have arisen in what situations. Thus this line of research should contribute greatly to design theories, including design principles. Due to limited resources and time, the detailed summary of user behavioral studies and the topology of information and communication technology use situations are outside the scope of this paper. Continued efforts should be put toward a better understanding of user behaviors in various situations, and such understanding should be incorporated in design theories and practice.

4 Discussion and Conclusion

In this paper, we introduce a set of design principles that leads to high motivational information and communication technology design, that is, to involve and satisfy people's motivational needs. These principles are rooted in modern theoretical understandings of the motivation that gives behavior its energy and direction. The motivational needs we identify are among the most fundamental needs of humans (Sheldon et al. 2001) that are pertinent to information and communication technology design. We augment our suggestions and discussions of these principles with existing design practices and information and communication technology use behavior studies. Our work here is one step closer to a motivational design theory. For example, our work can guide such design

practice: “in order to design for flow experience, support Principles 3 and 4” (which is what a design theory is intended: in order to achieve Y, do X). If a designer does not want to design for flow experience, then he can disregard these principles.

There are many areas that deserve future investigation. One is to test and refine these principles based on more information and communication technology design practice and user behavior studies. The other is to move forward with developing design guidelines that are specific to technology implementation and use contexts. Understanding what emotions should be intended for what types of technology use contexts is another area that calls for researchers’ attention.

It is noteworthy that traditional (or instrumental) usability also plays an important role that has behavioral consequences. Information and communication technology that is difficult to learn and difficult to use will induce negative emotions (such as frustration and annoyance) and thus generate avoidance behavior toward technology use. This is to say that despite recent interest in emotion, affect, aesthetics and fun in technology design, one should not forget the importance of traditional usability concerns. Existing empirical research indicates that certain information and communication technology qualities satisfy users’ basic needs, and thus function as “hygiene factors” for maintenance or removal of dissatisfaction, and other information and communication technology qualities promote performance and satisfy higher needs, and thus function as motivators and delight factors (Zhang et al. 2000; Zhang et al. 2001-2002; Zhang et al. 2001). Many hygiene factors identified by Zhang and her colleagues seem to resemble traditional usability factors. More studies are needed to confirm if traditional usability factors do function as hygiene and performance factors. Zhang and her colleagues’ studies also indicate that the perceived quality nature of certain information and communication technology design features may change over time as a user’s experience and familiarity with the information and communication technology features evolve (Zhang et al. 2001-2002; Zhang et al. 2001).

A motivational perspective thus may function as a framework to unite various information and communication technology design approaches to represent a holistic picture of issues in technology design and use. For example, a recent focus of the HCI field is on the dark side of information and communication technology use: the misuse and abuse behavior of technology (Angeli et al. 2006), and how technology design may prevent that from happening. Although there may be several perspectives one can take to investigate the misuse and abuse behavior of technology, one promising perspective would be the motivational.

Given that technology is part of one’s environment, there are other environmental factors (such as management interventions) that can also have motivational consequences if designed carefully. These factors and technology factors may be examined together. An understanding of the effect of combining certain technology features with management interventions (or job/work and incentive re-design) can feed back to technology design considerations and technology implementation and use strategies. The intellectual buy-in and emotional buy-in strategy for ERP implementation (Huang et al. 2001) and design is an example of this effort.

As mentioned earlier, in this paper, we present a set of design principles to illustrate the rationales, feasibility, and promise of taking a motivational perspective, yet we do not intend to provide a complete list of principles, which although beyond the scope of this paper is worth pursuing in a future effort. Thus we hope that this study is a call for further investigation and exploration of information and communication technology design and use with a holistic view, positive lens, and feed-forward attitude.

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