Digital Usage Behavior: A Sense Making Perspective

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Abstract

The proliferation of information technology has led to a concern about the ability of the digitally underserved to cope with life's challenges and opportunities. Although there has been recognition that the digital divide is more than technology access, there is an implicit belief that solving the access problem will also solve other aspects of the digital divide. We make the argument that variance in use involves cognition and is different than variance in access. We also argue that the context in which information technology is used makes a difference. We add to the digital divide research by proposing a model of digital sense making. The model helps explain the divide as a function of how information available through technology affects the ability to cope. We then test the model with empirical evidence derived from a study of 151 military families that had universal Internet access for a period of more than one year. We find that use of the Internet to scan, interpret and act is correlated with increased ability to cope.

1 Introduction

Access to information enabled by technological advances has been widely associated with shifts in the way that people live, work and play. Researchers have questioned whether the divide between the economically advantaged and disadvantaged will be widened or narrowed with inequities in access to digital information [11, 32].

The digital divide is a complex issue having several dimensions of inequality [24]. The global divide refers to differences in access to Information and Communications Technology between industrialized and developing countries. The social divide considers the gap between information rich and poor. The political divide is concerned with the gap between those who do and do not use digital media to engage, mobilize and participate in public life. In general digital divide research struggles with the implications of technology proliferation in creating inequities in the way that people are enabled to cope with life's challenges. On one hand proliferation of computing technology and increased global connectivity has been associated with leveling the playing field [13]. On the other hand the affluent in society have often dominated the initial adoption and use of emerging technologies [28].

Researchers have chronicled differences in the rate of adoption and usage between economically advantaged and disadvantaged groups [6]. It is estimated that less than one sixth of the world's population uses information technology in a way that makes a difference in their lives [3]. Researchers have found that those with greater Internet access also had greater access to education [29], income [22] and other resources that help people get ahead economically [16].

There are a number of different constituencies that are concerned with the digital divide. Societal inequities created by the digital divide are of great interest to policy makers concerned with the plight of the disadvantaged. Institutions that use information technology to transform the way that business is conducted are also concerned with implications of the digital divide. Business models that shift decision rights to employees, customers, or suppliers are based upon the expectation that digital information access will empower active voluntary participation [34]. Inequities in the way the information technology is appropriated and used can have important implications.

Concern over the transformational effects of use of information technology is not new. Although we often think of digital information

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technology as an important factor in the last half of the 20th century, paradigm shifts associated with information technology emerged as far back as the Victorian era with the introduction of the telegraph, that age's equivalent of the Internet [27]. Since that time the speed of innovation and adoption of information technology has been increasing at an exponential rate. Moore's Law (processing power), Kryder's Law (digital storage), and Gilder's Law (network bandwidth) have predicted that the exponential pace of change in information technologies that we have witnessed over the past several decades will continue in the foreseeable future. Information technology will continue to become much less expensive and dramatically smaller. The natural outcome of this exponential pace of information technology innovation is a world of pervasive computing. We define pervasive computing as an environment where every person, place or thing is digitally connected at a minimal cost without significant bandwidth constraint except in specialized cases.

Visions of a world of pervasive computing provide the foundation for a generation of e-business models that capitalize on the emergence of a more networked global society leveraging Metcalf's law [14]. Metcalfe's law states that the value or power derived from use of a telecommunications network is proportional to the square of the number of users of the system. A key to the emerging business models of mass customization [9], collaborative design [31], telemedicine[17], and other forms of distributed capitalism [34] is the assumption that individuals in general will utilize information enabled by technology to transform their behavior. However, there is evidence that universal access is not associated with changing behavior [1, 2, 10, 18].

Approaches taken to measure the digital divide may have important implications on findings. It is important to be thoughtful about the purpose of the tool, the level of analysis and method of approaching the data [4]. It is also important to consider the context of the research as having an effect on the results [4]. Digital divide studies that do not distinguish differences between technology access and use may not provide a great deal of predictive value. Given the rate of change, studies that chronicle the digital divide associated with the current state of technology access are obsolete before they are even printed. Researchers and practitioners alike may benefit from a theoretical base that is less effected by the rate of change in access on which to conduct research about the digital divide.

An understanding of how IT is used to make a difference in addressing important life events may be the key to predictions of the digital divide not only for purposes of social equality but also to understand how the digital divide may effect emerging business models. The digital divide as it pertains to digital behavior demands more study.

2 Theory

2.1 The Digital Divide

The value captured by individuals utilizing the Internet continues to be the subject of a great deal of debate. The greatest value of new technology typically involves using the technology in new ways, for new applications in new areas by new people[7]. However, technology is often adapted to ongoing social practices and concerns rather than "influencing society as an external force" [12]. This may be because new uses of information technology involve transformation of how we fundamentally make sense of the world changing the principles that govern established norms.

Whereas some academics and practitioners forecast dramatic shifts in the way that we live work and play [32], others expect resistance and predict the status quo [26]. From a technological determinist point of view, pervasive computing will lead to dramatic changes in the global competitive landscape affecting the creation and delivery of more personalized goods and services [13, 14]. Alternative theories question whether information technology and access to volumes of information transforms [34] or reinforces habitual behavior [25].

Differences in appropriation of value from Internet use has been described as following similar patterns as prior waves of technological proliferation with the implication that Internet adoption will follow a similar s-curve [8]. However the research has often mixed access and use with the implication of following similar adoption curves. We purposely seek to examine the digital divide given a state of universal access thus focusing on the behavioral aspects of the digital divide that have been intertwined with access in prior research.

The central premise of our study is to examine the relationship between cognition, action and performance at an individual level of analysis using theories of sense making to associate new digital behavior with individual

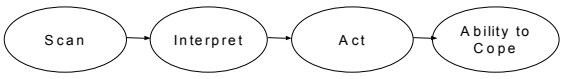
perceptions of coping ability. The focus of our investigation is to understand variance in use of digital information as a cognitive process that effects the way that individuals make sense of the world

2.2 Sense Making

The socio-cognitive view taken by Weick [33] and others argues that the decision making process involves interaction between individuals and their environment over time. The interaction between the environment and the individual is two-sided. During the sense making process an individual is influenced by his/her environment while at the same time shapes his/her interpretation of the environment to support his/her view.

There is along history of research that has explored the effects of decision maker's interpretations of information and performance outcomes [5, 30]. We leverage the strategic sense making literature as the basis for our conceptual framework of digital behavior. We associate changes in the outcome variable of coping with three key sense making processes – scanning, interpreting and taking action in response to changes in the environment. Our model, adapted from Thomas et al (1993) [30], is depicted in figure 1. We substitute ability to cope for their previous performance outcome variable.

Figure 1 - Socio-Cognitive Model of Digital Sense Making



2.2.1 Scanning

Scanning involves information gathering about the important events in the general environment and therefore is normally seen as an antecedent to interpreting and acting [19, 30]. Information technology use is often associated with reducing search costs by increasing access to more varied information sources requiring less time and effort.

2.2.2 Interpretation

The process of scanning is highly correlated with the process of interpreting. Interpreting information is a cognitive process that allows decision makers to make sense of signals in the environment to determine those that warrant responsive action. Given the vast amount of information available through the Internet, consumers in the health care marketplace often suffer from information overload [15] or even worse, misinformation overload [21], making them less confident to take action because of conflicting, confusing, erroneous or superfluous information. Thomas et. al. [30] explained that individuals will seek to interpret signals in the environment as being either controllable or not within their control. In the context of healthcare, interpretation is a cognitive process by which an individual assesses whether they have the means to affect a positive change in the healthcare that they seek. As an example a patient may gain a better understanding of the diagnosis of a healthcare problem by comparing symptoms to those listed on a healthcare web site, identifying possible remedies or determining possible treatments that could be considered. This process of interpreting information about diagnoses can help empower a patient to become more proactive in their treatment with medical professionals. The process of interpretation involves making a personal judgment of the probability that an identified issue can be resolved by proactive action; a judgment of whether the issue is "controllable".

Proposition 1: Information scanning activity through the Internet is associated with interpretation of issues as being controllable or not controllable.

2.2.3 Action

Interpretation of signals as controllable has been associated with making changes to take action in response [30]. The value of decisions made in response to signals in the environment is dependent upon the ability to take effective and timely action. To be most effective, responsive actions often require transformation of habitual behavior. For the purpose of this research we focus on transformational behavior that utilizes information technology in a meaningful way to respond to signals that have been deemed to be controllable.

Proposition 2: Identification of important issues as controllable will be positively related to changing behavior to utilize information technology to take responsive action.

2.2.4 Ability to Cope

There is a body of research linking processes used to scan and interpret signals in the environment that transform the way that organizations respond to performance outcomes in organizational decision making contexts. As an example, Thomas et al (1993) [30] examined the effectiveness of substantial changes made to product and/or service offerings in response to signals in the market by measuring performance outcomes. From an individual level of analysis, individuals make changes to the way that they react to signals in their environment to help gain better control allowing them to cope with life's challenges.

Coping is a process used to respond to stress. Lazarus [20] identified that stress consists of three processes. *Primary appraisal* is the process of perceiving a threat to oneself. *Secondary appraisal* is the process of bringing to mind a potential response to the threat. *Coping* is the process of executing that response. Integral to this process is the need to take action in response to an assessment that the stressful issue is controllable. In our study we view the ability to cope as an important outcome related to use of information systems to take action.

Proposition 3: Use of the information technology to take action will be positively associated with ability to cope.

3 Methods

3.1 Military Family Internet Use

We gathered data from a panel of military families who were provided universal high-speed access to the Internet through a standard PC with high-speed access from home. These families volunteered to participate in a series of studies that sought to gain better insight on the effect of access to the Internet on behavior during a time period of from one to three years.

3.2 Questionnaire

We gathered data for the research discussed in this paper through an on-line survey that was administered at the conclusion of the research project. A parent that had utilized the computer system during the study period in each household completed the survey. The parent served as the key respondent for the entire family. We gathered data from 151 of the 250 families that had participated in the research program for a response rate of sixty percent.

3.2.1 Independent Variables

The on-line survey included multi-item scales with Likert response formats for scanning, interpretation, and action variables for two different contexts. We operationalized action as behavior utilizing the Internet to accomplish tasks related to the context of healthcare or education. Interpretation behavior was operationalized as judgments that were specifically related to the controllability of identified issues. The survey questions were adapted from Thomas et al (1993) to fit the context of this study. Cronbach alphas for all measurements were greater than .90.

3.2.2 Dependent Variables

Items related to coping were gathered for each of the contexts: healthcare and education. The survey questions were taken from a previous set of studies conducted by the U.S. Army Community and Family Support Center (CFSC), in conjunction with the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) to evaluate the well being of military families [23]. Cronbach alphas for all measurements were greater than .83.

3.2.3 Control Variables

We used demographic data to control for factors that have been traditionally associated with the digital divide including income and education. The three measures of demographic data included level of formal education of both spouses as well as family income.

3.3 Data Analysis Methods

We tested the relationship among the variables using path analysis. This analytical technique allowed us to identify the direct and indirect effects of the three sense making activities (scan, interpret and act) on the ability to cope controlling for demographics.

4 Discussion of Findings

4.1 Healthcare

The model confirmed the effect of sense making activities of scanning, interpreting and acting on ability to cope. Figure 2 depicts a LISREL model of our research model for the context of healthcare. Ability to cope was clearly affected by action taken in response to the interpretation of signals scanned in the environment. The data supported proposition 3 showing a strong relationship between Act and Coping (R^2 = .92). Proposition 2 was also supported as the data demonstrated a relationship between Interpret and Act (R^2 = .90). Finally proposition 1 was supported with the relationship between Scan and Interpret (R^2 = .89). Control factors related to education and income had little effect (R^2 = .05),

Figure 2 - LISREL Path Diagram - Healthcare

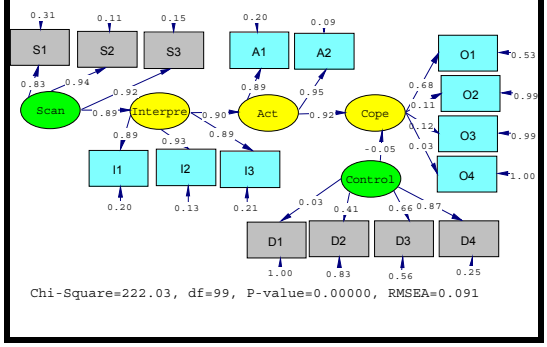
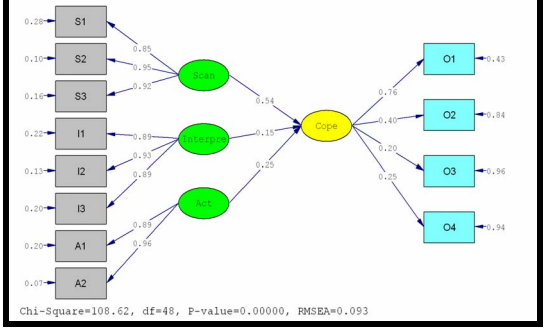


Figure 3 identifies an alternative model in which we tested the direct effect of each of the sense making activities on ability to cope. In the alternative model each of the variables had less of an effect on Coping than in the theoretical model, Act (R^2 = .15), Interpret (R^2 = .20), Scan (R^2 = .54).

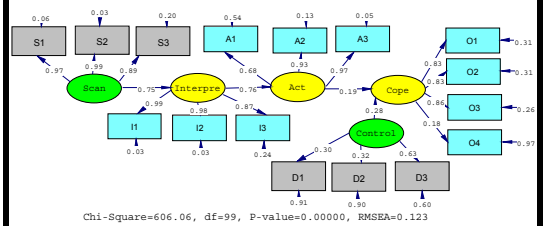
Figure 3 – Alternative LISREL Path Diagram - Healthcare



4.2 Education

Although the model depicted in Figure 4 confirmed the theoretical relationship between the activities of scan, interpret and act, the effect on coping described in proposition 3 was not as strongly supported as in the context of healthcare (R^2 = .19). However, propositions 1 and 2 were supported as the data demonstrated a relationship between Interpret and Act (R^2 = .76) as well as the relationship between Scan and Interpret (R^2 = .75). This result may reflect the military family's frustration with their ability to positively affect change in the education of their children rather than their willingness to change their approach to help their children by utilizing information technology.

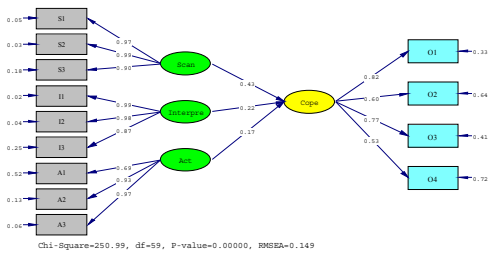
Figure 4 – LISREL Path Diagram - Education



The alternative model depicted in figure 5 tested the direct relationship between each of the independent variables and the ability to cope. In contrast to the healthcare context, the effect of scanning activity had a greater effect on coping ability than the construct of Act in the theoretical model (R^2 = .43) vs. (R^2 = .19). This again shows that there is a perceived usefulness of being able to find the right information but a frustration on how to utilize information

technology in ways that will make a difference in their ability to cope with educational issues.

Figure 5 – Alternative LISREL Path Diagram -Education



5 Conclusions, Limitations and Future Research

5.1 Conclusions

This research contributes to the discussion about the digital divide by untangling digital behavior from digital access by explaining behavior as a cognitive process. Past research on the digital divide has identified the need to look beyond access to investigate how digital information makes a difference in the way that we live work and play. These studies have included education and income among other demographics as determinants of digital inequality. To help untangle the variables that effect access from those that effect use, we provided universal access to our subjects over an extended period of time. We found support for the notion that a digital divide exists given universal access. Although past studies found a correlation between income and education with digital behavior, our study did not support the effect of income or education on the ability to cope. The differences in education from GED to advanced degree did not correlate with how digital information is leveraged for the benefit of the family. Income also did not appreciably make a difference. This has important implications to guide initiatives that seek to provide access to the digitally deprived. Demographics did not explain differences in how the subjects thought about use of information technology to scan, interpret and act. This may be an indicator that given universal access, demographics that effect access are less important. This makes sense as we consider the use of more established technologies such as the telephone. Most would agree that education or income do little to predict how a phone is utilized to cope.

We confirmed that the model of sense making developed by Thomas et al. [30]applies to the phenomenon of the digital divide explaining variance in the outcome of coping as a function of sense making activities. We also found that the context makes a difference. Although individuals may utilize information that is enabled by technology to make sense of the world they may not be able to feel as if they can effect their ability to cope with all contexts to the same degree.

5.2 Limitations

Due to privacy issues, we did not capture the actual use of the computer by the respondents but rather captured measures of both independent and dependent variables using a single survey instrument at a single point in time. Although capturing both independent and dependent variables using the same survey is common we recognize that it may be subject to common method bias. We randomized the order in which the questions were presented each time an individual took the survey to reduce method bias due to question order.

5.3 Future Research

The research provides a basis for further exploration of the digital divide from a behavior transformation point of view. If the Internet is associated with changing the way that we live, work and play it is because it is utilized in new ways to find and respond to signals in our environment that will assist in coping with these challenges. Providing digital access and basic education to assure literacy may not be enough to transform behavior. Although we did investigate the impact of two commonly used demographics (income and education) as alternative explanations for differences affecting a person's ability to cope, future research should consider other explanations identified by the European Social Survey database including media use, regional characteristics, and general skill.

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