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Communicator Style and Technology Preferences: A New Examination of Fit, Adoption, Social Diffusion and Dimensionality

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Communicator Style and Technology Preferences: A New Examination of Fit, Adoption, Social Diffusion and Dimensionality

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An abstract of
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2010

Abstract

Communicator Style and Technology Preferences: A New Examination of Fit, Adoption, Social Diffusion and Dimensionality

By Joycelyn L. Streator

Effective collaboration is becoming increasingly critical as knowledge workers are more distributed and rely heavily on various modes of communication (i.e. voice, e-mail, instant messaging, social networking) to successfully accomplish tasks. Just as individuals have unique styles for communicating face-to-face; my research explores the relationship between individual communication styles and information and communication technologies (ICTs). In addition, I investigate the influence of ICTs on the diffusion of communication norms within organizations. The results of my research contribute to Media Selection Theory and will help knowledge workers better optimize the use of communications technologies.

Communicator Style and Technology Preferences: A New Examination of Fit, Adoption, Social Diffusion and Dimensionality

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Also, special thanks to my mother, Joyce, my brothers Lionel Jr., Loren, and Landon, sisters-in-law Jen and Daaiyah, and cousins Sabrina and Chris. I am grateful for all the laughter and support. Our family's humor has always been a unique source of joy through the ups and downs. I would also like to express appreciation to my husband's family members, Luella Viot, Joyce Streator, and Lynette Ewing, for all of the ways that they loved and supported my children during this process.

And to my Dad who was such an important part of this journey from the beginning and continues to be with me in spirit, I benefit from your love and wisdom every day of my life.

And finally, to my extraordinary husband, Jeffrey, my darling baby girls, Joyce and Janice, and my fun-loving stepchildren Janae and Micaiah, your very presence encouraged me to keep going and continues to inspire me… "I love you all the time."

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Overview

The purpose of this dissertation is to expand our current understanding of media selection theory by examining how individual factors influence choice among information and communication technologies (ICTs). In addition, this dissertation augments the media capabilities framework seen in Media Synchronicity Theory with a new capability: discretion.

As new communication technologies offer unprecedented ways for individuals to interact and collaborate, much of media selection theory fails to address the complexities that arise as new modes of communicating are created and combined. In addition, past empirical studies lack the robustness needed to extend the findings to newer technologies. This dissertation addresses the widening gap in the media research that has arisen due to the myriad of interaction modes offered by new communication technologies. It also addresses the absence of a robust framework for examining media in empirical studies. The overall theme connecting these chapters is an exploration of the complex dynamics that arise with mixing communication media. Specifically, I plan to explore 1) individual traits and selection of communication media, 2) electronic communication and the spread of communication norms and 3) the development of an instrument to gage user preference for media capabilities and the introduction of a new capability. This research provides a bridge between theory in the Information Systems and Communications literature.

In today's work environment, effective communication is becoming increasingly critical. Knowledge workers are more distributed and rely heavily on "repertoires," or mixed modes of communication (i.e. voice, e-mail, instant messaging), to successfully accomplish tasks (Belanger et al. 2001; Watson-Manheim et al. 2007). Researchers have found that workers are using an assortment of communication technologies to achieve differing communication goals (Bélanger et al. 2006). Information systems and communication have become so interwoven that some researchers suggest that the use of information systems has shifted emphasis from computing to communication (Frey 1999). Yet, as workers in distributed environments employ diverse communication techniques to create more complex communication structures the effects on group dynamics and performance are unclear.

On the technology front, an increasing number of vendors are offering unified communications (UC) solutions that integrate communications with business applications. This shift is made possible by the rise in TCP/IP networks and open application servers. Improvements are realized through more efficient work processes, greater information availability, and improved individual performance. Coincident with the increase in unified communications, the era of "mass personalization" yields applications that can be adapted in real time to fit the unique needs of individual end users. The increase in the number of communications options along with the ability to select and customize communications applications "on the fly" opens an entirely new realm of possibilities for communications technologies to reflect the unique preferences and nuances of the individual. There is a growing need to understand how knowledge

workers can more effectively manage numerous communication options and avoid information overload.

Communication networks within today's organizations can be characterized as complex adaptive systems as new information and computer technologies (ICTs) allow communication norms and patterns to emerge bottom-up. Also, the impact of the changes in communication patterns within organizations is not easily decomposable or predictable (Clippinger 1999).

A majority of IS research on communication has centered on studying how the attributes of a single communication medium affect media selection (Daft et al. 1986). However, today's technology-infused work environment provides a mixture of technologies and capabilities that enable users to create uniquely individual communication choices.

I argue that the increasing communication repertoire available to knowledge workers presents a unique set of complexities by which to explore how individual select and are impacted by these technologies. Communication repertoires are defined as "the collection of communication channels and identifiable routines of use for specific communication purposes" (Watson-Manheim et al. 2007). Previous research on media selection has emphasized the use of a single medium or application. Only recently have investigators begun to expand media choice research beyond comparison of single applications and instead recognized that individuals often employ multiple media.

This research also explores media selection based on a broader, more universal set of media capabilities rather than emphasizing particular technologies. Application specific empirical studies quickly become obsolete as technologies become outdated and are replaced. This research will look at more salient capabilities to gain a deeper understanding and provide a more substantial contribution to theory.

The central theory being used as a foundation for all three chapters in this dissertation is Media Synchronicity Theory. Figure 1 below provides an overview of Media Synchronicity Theory and highlights the areas of contribution provided by this dissertation. Greater detail about each of the chapters is given below.

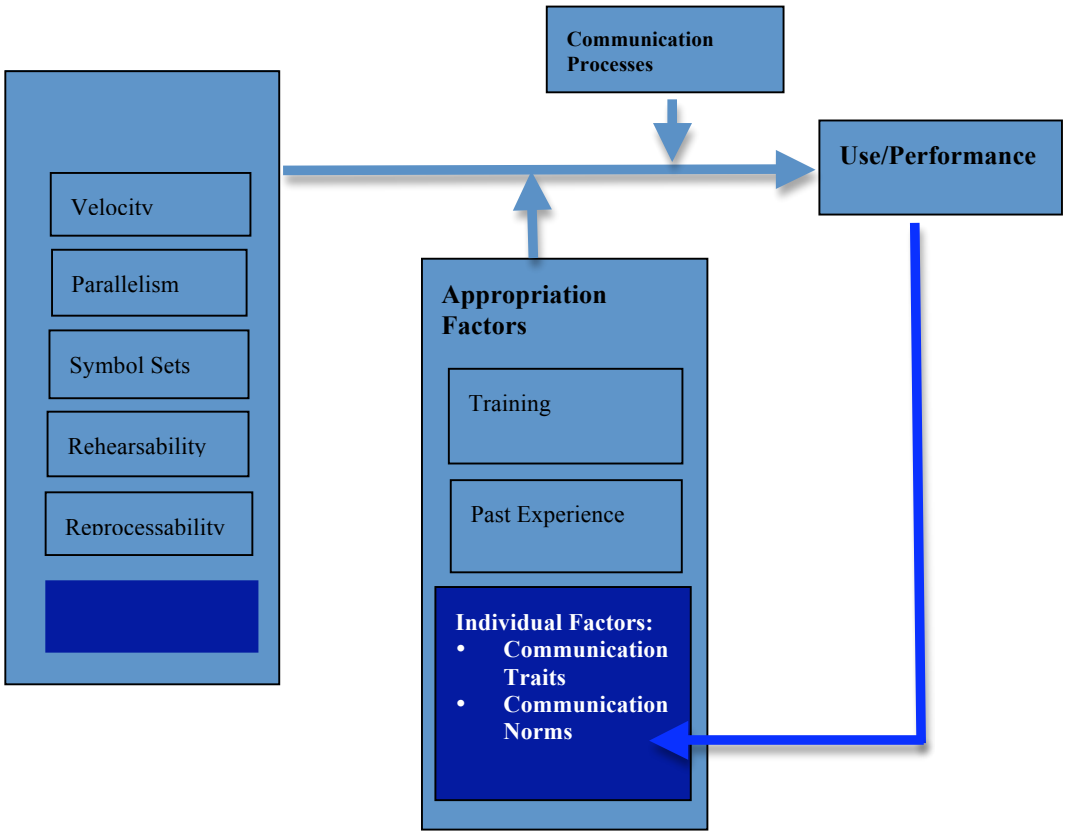

Figure 1: Overview of Media Synchronicity Theory and Dissertation Contributions

The dissertation will be organized as follows. The first chapter will examine the role of individual traits as an appropriation factor. Specifically, individual communication traits will be studied in relationship to the communication capabilities defined by Media Synchronicity Theory (Figure 2). The central question being address in this chapter is: When knowledge workers have an array of communications technologies available, do communication traits of the individual influence technology choice? It is hypothesized that individuals with certain communication traits will show a greater preference for some communication capabilities over others. This study is significant because it is among the few to explore the role of individual communication traits as they relate to media selection. In addition, it is the first to explore individual traits within the lens of Media Synchronicity theory and thereby extends the current understanding of how the communication style of the individual mediates the relationship between technology capabilities and actual use.

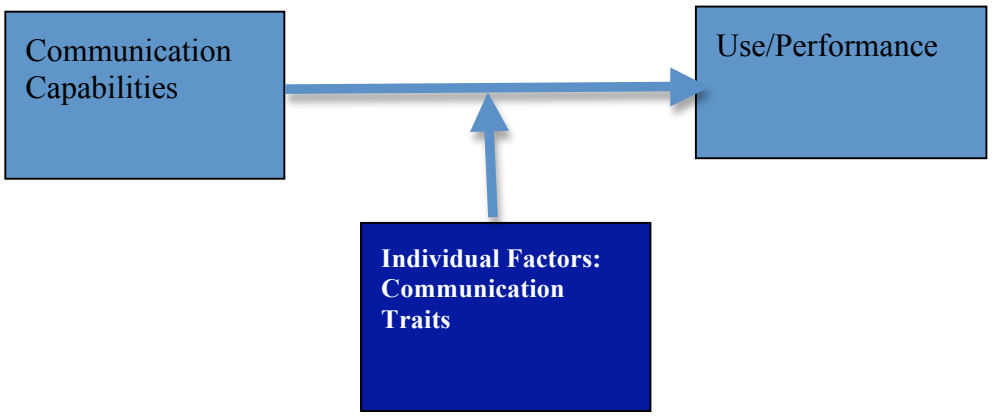

Figure 2: Communication Traits Model

ICTs enable the range of possible interactions that can produce new and unexpected changes in communication norms. For example, managers may inadvertently change organizational communication norms when declaring a new mode of communication (e.g. email) the official channel for certain types of interaction (Orlikowski et al. 1994). In addition, researchers have began looking at how ICTs impact self-disclosure, expressiveness, and other communication behaviors thought to be heavily influenced by norming processes (Joinson 2001) (Tidwell et al. 2002). The second chapter explores the relationship between the use of ICTs and communication norms. It examines the complexities and dynamics of how the use of communication media influences norms (Figure 3). This study employs the use of a simulation to compare the spread of norms as individual rely more heavily on electronic communication channels to reach remote others rather than traditional face-to -face communication to interact with those in closer physical proximity. The theoretical basis guiding this study is Adaptive Structuration Theory. Accordingly, it is hypothesized that as users structure technology to meet an increasing number of their communication needs, this use alters social processes, specifically the spread of norms. This research provides a unique extension to Axelrod's Culture Model. In addition, it contributes to Media Synchronicity Theory by exploring the feedback between ICT use and communication norms, an appropriation factor.

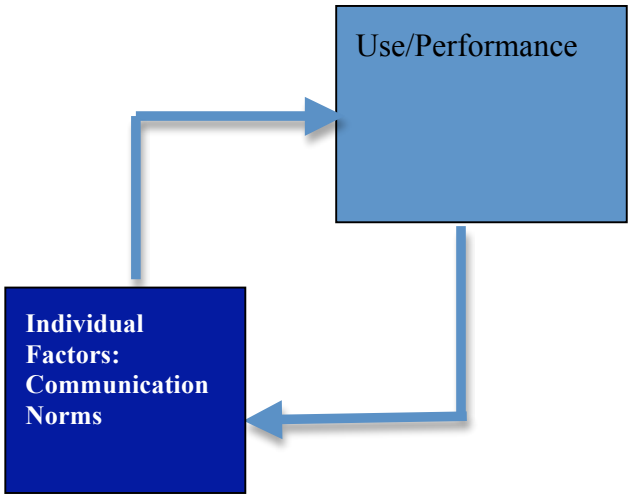

Figure 3: Communication Norms Model

The complex and ever changing nature of information systems makes it difficult to identify salient features of communication systems. IS research can greatly benefit from systematic classification schemes that allow the comparison of technology features and effects without being subject to the ephemeral nature of underlying technologies. From a practitioner's standpoint, organizations must determine which aspects of communication will be changed and disrupted by rearranging and replacing communications technologies (DeSanctis et al. 1994a). The third chapter examines the media capability classifications presented in Media Synchronicity and proposes new capabilities that expand Media Synchronicity Theory (Figure 4). In addition an instrument for measuring preferences for media capabilities is introduced.

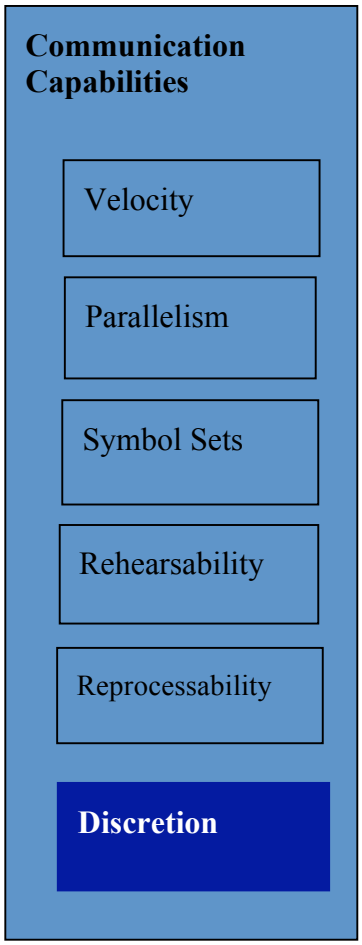

Figure 4: Communication Capabilities

Literature Review

Early Approaches: Media Richness and Context

Early media selection theories center on a common question: Why is one medium of communication better suited for a particular task than another? At the origin of this line of inquiry are a series of theories and empirical studies that attempted to address this question by matching media trait to task. Media Richness Theory suggests that media can be compared based on its richness and that rich media – those that allow for greater feedback, cues, language variety, and personal focus -- were better suited for equivocal tasks (Daft et al. 1986). In addition, Media Richness Theory suggests that media can be ranked based on its relative richness with face-to-face being the richest media and memos and letters being the leanest (Daft et al. 1987). The strength of Media Richness theory has waned in recent years as researchers point out a single medium may be multi-trait and that any attempts to rank specific media are of questionable value.

Beyond Daft's Media Richness theory a flurry of empirical studies began to shift emphasis toward exploring the role of context. Specifically: How do circumstances surrounding a communication event influence media selection? These contextual factors are argued to be socially constructed (Fulk 1993), (Miranda et al. 2003), (Webster et al. 1995). For example, task urgency (Steinfield et al. 1986), group size (Miranda et al. 2003), familiarity with technology (Carlson et al. 1999), and perceived importance of the decision have all been shown to impact media choice. More recently, Yoo and Alavi

suggest that physical traits of the media combine with the social and institutional context to influence meaning and, therefore, selection of specific media (Yoo et al. 2001). While contextual factors appear to mediate media selection, empirical studies have yet to be synthesized into a comprehensive theory regarding media choice.

The most recent scholarship on media choice takes a more sophisticated look at defining media capabilities and recognizes that media choice in today's business environment involves selecting and mixing multiple media. The central research question has shifted: How do individuals select among combinations of media? Watson-Manheim suggests that employees develop "communication repertoires" and that the selection of media may vary between communities and organizations due to different communication purposes, institutional and situational conditions (Watson-Manheim et al. 2007). In addition, it has been suggested that individuals select sequential and concurrent combinations of media to achieve communication goals such as message acknowledgement, enhancement of mutual understanding, and participation in multiple communication interactions (Bélanger et al. 2006). The shift from emphasis on single media selection to multiple media selection is thought to be influenced by the rise of more distributed work environments (Woerner et al. 2004). In addition, scholars have begun to emphasize that media selection is based on more than just the physical aspects of the medium (Nardi et al. 2002).

Media Capabilities

Arguably one of the most influential contributions to current scholarship on media selection is Media Synchronicity Theory (Dennis et al. 1999). Media Synchronicity Theory suggests that communication can be encapsulated in two key processes: conveyance and convergence. In addition, Dennis suggests that media are best analyzed based on communication capabilities, and Media Synchronicity Theory provides a concise summary of the theoretical foundation for each. These capabilities (feedback, symbol variety, parallelism, rehearsability, and reprocessability) can be matched with the communication processes of conveyance or convergence to optimize communication depending on the level of equivocality associated with the task being performed (Dennis et al. 1999).

Media Synchronicity Theory provides a much needed foundation for categorizing media beyond physical properties. Instead the media capabilities framework provides a high level view of media affordances that transcends specific technologies. This framework for categorizing capabilities will be employed and expanded in the current research. In addition to the capabilities proposed by Dennis, this research will explore an additional capability afforded by communications media: discretion.

Appropriation Factors

Adaptive Structuration Theory provides the most comprehensive theoretical lens for framing the interplay between technology and social structures. It posits that technology

and social behavior mutually shape one another and are intertwined in a recursive relationship (DeSanctis et al. 1994b). Desanctis and Pool (1994) note that appropriation of technology is evidenced by decisions whether to use technology, decisions whether to use the technology in a singular form or blend it with other technologies, and interpretation of the operation of the technology. Social structures affect the way in which technology is appropriated. In this research, I examine two appropriation factors: individual communication traits and communication norms. Taken together, individual traits and norms play a significant role in shaping and individual's communication style, which in turn influences behavior, specifically ICT use. A more in-depth discussion of communication traits and the interplay between norms and technology use is given below.

Individual Factors: Communication Traits

Much of the foundation of communication theory lies in the work of Shannon and Weaver. More recently, communication theorist Marshall McLuhan set forth the notion that the "medium is the message" and suggested that "the personal and social consequences of any medium - that is, of any extension of ourselves - result from the new scale that is introduced into our affairs by each extension of ourselves, or by any new technology" (McLuhan 1964). That is to say that the medium or media by which we choose to communicate a message uniquely affects message or interpretation being received. In the same way that individuals may choose to communicate with certain gestures, intonations, and expressions, communication media provides an extension of the self and extends the individuals expression capabilities.

It has been suggested that an individual's style of interacting is a factor in the appropriation of communication technology (DeSanctis et al. 1994a) . However, to date there have been few studies regarding how characteristics of the individual affect media selection (Rice 1992), (Barkhi 2002). These studies were conducted using a single communication medium at a time when knowledge workers had a smaller array of communication options available. Other researchers have noted that individuals develop their own style of communication based on personal preferences such as desire for confidentiality (Gotcher, 1997) (Straus 1996). And while much communication research has been focused on the group level, individuals vary widely in their use of communication technologies (Mantei 1989).

Individuals have a unique set of communication traits that, in the most basic sense, can be defined as the manner in which one communicates. More specifically, communication traits are being defined as the way one verbally and nonverbally interacts to signal how meaning should be interpreted (Norton 1983). Traits are distinguishable from states because traits 1) have empirically high retest abilities and 2) are not affected by transient changes (Zuckerman 1983). In addition, a majority of traits are thought to be possessed by all individuals in varying degrees (McCroskey 1998).

The model set forth by this research proposes that a relationship exists between an individual's communication traits and the communication capabilities that the individual

will prefer. The need for these capabilities drives the selection of communications technologies to convey a message.

Structuration and Communication Norms

Adaptive Structuration Theory provides the most comprehensive theoretical lens for framing the interplay between technology and social structures. It posits that technology and social behavior mutually shape one another and are intertwined in a recursive relationship. (DeSanctis et al. 1994b). Accordingly, new norms for group interaction can emerge as communication technologies are appropriated.

Today's communication technologies enable and constrain interaction in the workplace through support of coordination and communication while providing procedures for interpersonal exchange (DeSanctis et al. 1994b).

The process by which technology impacts the norms can be thought of in two stages: 1) communication norms are projected electronically and 2) communication norms are transferred between individuals electronically. A number of studies indicate that individuals project personal styles, previous experience, and norms via electronic communication (Weisband et al. 1995; Wilkins 1991). Electronic communication may be affected more by social conditions than the medium itself (Abel 1990), (Lea 1992). In addition, the reciprocal relationship, when norms influence electronic communication, has also been examined (Ferrara et al. 1991).

As the use of communication media becomes more widespread, new communities with differing perspectives and communication norms are likely to emerge within and outside of existing organizations and communities (DeSanctis et al. 1999b). Individual identification is thought to be impacted by computer-mediated communication (Wiesenfeld et al. 1999) and communication norms, which are reflected in an individual's attitudes and beliefs and are influenced by the use of ICTs. These norms in turn influence message interpretation and response. Through repeated interaction, groups of individuals develop shared understanding and expectations of behavior, including communication practices. Research has shown that groups separated by physical distance can become very cohesive, and electronic interaction begins to mirror the interactional effects of a social community (Abel 1990; Wilkins 1991). Aside from bridging physical separation, ICTs bridge functional divides. Within organizations, electronic communication facilitates boundary spanning (DeSanctis et al. 1999b) such that culturally and functionally diverse parties have the opportunity to interact and exchange ideas.

Chapter 1: Communicator Traits and Information and Communication Technology Preferences

Communication is at the core of group interaction and performance. While the process of communication consists of interaction among multiple parties, each individual brings a unique set of individual traits to the encounter. In today's work environment effective communication is becoming increasingly critical. Knowledge workers are more distributed and rely heavily on various modes of communication (i.e. voice, e-mail, instant messaging) to successfully accomplish tasks (Belanger et al. 2001). Researchers have found that workers are using an assortment of communication technologies to achieve differing communication goals (Bélanger et al. 2006). Information systems and communication have become so interwoven that some researchers suggest that the use of information systems has shifted emphasis from computing to communication (Frey 1999). Yet, as workers in distributed environments employ diverse communication techniques to create more complex communication structures the effects on group dynamics and performance are unclear.

From the practitioner's perspective, an increasing number of vendors are offering unified communications (UC) solutions that integrate communications with business applications. This shift is made possible by the rise in TCP/IP networks and open application servers. Improvements are realized through more efficient work processes, greater information availability, and improved individual performance. Coincident with the increase in unified communications, the era of "mass personalization" yields

applications that can be adapted real-time to fit the unique needs of individual end users. The increase in the number of communications options along with the ability to select and customize communications applications "on the fly" opens an entirely new realm of possibilities for communications technologies to reflect the unique preferences and nuances of the individual.

A majority of IS research on communication has centered on studying how the attributes of communication media affect media selection (Daft et al. 1986). However, today's technology-infused work environment provides a mixture of technologies and capabilities that enable users to create uniquely individual communication choices. This research explores the role of individual communication traits in electronic communication, similar to individuals' unique styles for communicating face-to-face.

The purpose of this research is to explore the relationship between individual communication traits and media choice. Specifically, the research question under investigation is: When knowledge workers have an array of communications technologies available, **do communication traits of the individual influence technology choice?** This research uses theories related to communication traits and media choice as the foundation for an empirical study. It is among the first to investigate the relationship between individual communicator traits and communications technology choice. Also, this study explores technology selection based on a broader, more universal set of technology capabilities rather than emphasizing particular technologies. Application specific empirical studies quickly become obsolete as technologies become outdated and

replaced. Media Synchronicity Theory provides a foundation to examine more salient technology traits and capabilities to provide a more substantial contribution to theory.

Relevant Theory

The empirical study proposed in this research provides a bridge between two bodies of theory Media Choice Theory and Communications Theory. The following section gives an overview of prominent theoretical and empirical developments within these two bodies.

Overview of Media Theory

Early media selection theories center on a common question: Why is one medium of communication better suited for a particular task than another? At the origin of this line of inquiry are a series of theories and empirical studies that attempted to address this question by matching media trait to task. Media Richness Theory suggests that media can be compared based on its richness and that rich media – those that allow for greater feedback, cues, language variety, and personal focus -- were better suited for equivocal tasks (Daft et al. 1986). In addition, Media Richness Theory suggests that media can be ranked based on its relative richness, with face-to-face being the richest media and memos and letters being the leanest (Daft et al. 1987). The strength of Media Richness Theory has waned in recent years as researchers point out a single medium may be multi-trait and that any attempts to rank specific media are of questionable value.

Beyond Daft's Media Richness Theory, a flurry of empirical studies have begun to shift emphasis toward exploring the role of context. Specifically: How do circumstances surrounding a communication event influence media selection? These contextual factors are argued to be socially constructed (Fulk 1993), (Miranda et al. 2003), (Webster et al. 1995). For example, task urgency (Steinfield et al. 1986), group size (Miranda et al. 2003), familiarity with technology (Carlson et al. 1999), and perceived importance of the decision have all been shown to impact media choice.

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One of the most influential contributions to current scholarship on media selection is Media Synchronicity Theory (Dennis et al. 1999). Media Synchronicity Theory suggests that communication can be encapsulated in two key processes: conveyance and convergence. In addition, Dennis suggests that media are best analyzed based on communication capabilities, and Media Synchronicity Theory provides a concise summary of the theoretical foundation for each. These capabilities (feedback, symbol variety, parallelism, rehearsability, and reprocessability) can be matched with the communication processes of conveyance or convergence to optimize communication depending on the level of equivocality associated with the task being performed (Dennis et al. 1999).

Media Synchronicity Theory provides a much needed foundation for categorizing media beyond physical properties. This framework for categorizing capabilities will be employed and expanded in the current research. Table 1 below provides an overview of communication capabilities as described in Media Synchronicity Theory.

Table 1. Communication Capabilities

Capability	Definition
Feedback	The ability to communicate and receive evaluative or corrective information on a previously transmitted message
Symbol variety	The ability to provide the numerous cues and language variety (Daft et al. 1986); (Dennis et al. 1999)
Parallelism	The ability to engage in more than one separate conversation (Dennis et al. 1999)
Rehearsability	The ability to compose and edit a message to ensure exact meaning prior to communication
Reprocessability	The ability to repeatedly process, review, or recall a message

Research related to Media Synchronicity Theory has primarily been focused on communication processes and communication tasks (Dennis et al. 1998b). However, researchers note that individual perception plays a role in the selection of communication channels (Zmud et al. 1990). It has been suggested that individual styles transfer to electric media. Some individuals prefer face-to-face and telephone to computer-mediated communication (Murray 1991) while others with a high concern for confidentiality may use electronic media differently (Gotcher et al. 1997).

Unlike previous research, the current research moves beyond a task-oriented perspective of media selection and explores theory surrounding the traits of individual communicators as a basis for media selection. In other words, this research will attempt to explore how an individual's unique communication fingerprint corresponds to the selection of media based on media capabilities. The following section provides a discussion communicator style theory.

Communication Theory

Much of the foundation of communication theory lies in the work of Shannon and Weaver. Their communication model proposes that:

> Encoding and decoding of a message, that is the process of transforming communications inside our head into a medium or channel through which they can be decoded on the other side. The process of encoding and decoding and the channel properties (i.e. noise and feedback) were thought to affect the fidelity of the message received in light of the intended message sent (Shannon, Weaver 1949).

Communication theorist Marshall McLuhan sets forth the notion that the "medium is the message" and suggests that "the personal and social consequences of any medium - that is, of any extension of ourselves - result from the new scale that is introduced into our affairs by each extension of ourselves, or by any new technology" (McLuhan 1964). That is to say that the medium or media by which we choose to communicate a message uniquely affects the message or interpretation being received. In the same way that individuals may choose to communicate with certain gestures, intonations, and expressions, communication media provides an extension of the self and extends the individuals expression capabilities.

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Individuals have a unique set of communication traits that, in the most basic sense, can be thought of as the manner in which one communicates. More specifically, communication traits are being defined as the way one verbally and nonverbally interacts to signal how meaning should be interpreted (Norton 1983). Traits are distinguishable from states because traits 1) have empirically high retest abilities and 2) are not affected by transient changes (Zuckerman 1983). In addition, a majority of traits are thought to be possessed by all individuals in varying degrees (McCroskey 1998).

The model set forth by this research proposes that a relationship exists between an individual's communication traits and the type of communication capabilities that the individual will prefer. The need for these capabilities drives the selection of certain communications technologies to convey a message. For the purposes of this study, several widely accepted and well-researched communication traits are being used. These traits are described in Table 2 below.

Table 2: Communication Traits

Communication Trait	Description
Argumentative	Predisposes the individual in communication situations to advocate positions on controversial issues and to verbally attack the positions of others on these issues. The individual perceives this activity as an exciting intellectual challenge, a competitive situation which entails defending a position and "winning points"
Apprehensive (Group Communication)	Fear and/or anxiety about communicating
Animated	Provides frequent and sustained eye contact, uses many facial expressions and gestures often
Articulate	Concern for of correct pronunciation, fluent speech, proper grammatical construction of sentences, appropriate word choice, and clear organization of ideas
Witty	Diffuses anxiety and tension. Humor as a response to incongruity, embarrassment or aggression serves to reduce the arousal of individuals in social situations

Hypotheses

This research posits that a relationship exists between the communication traits of individuals and the individual's preference for ICT capabilities. Communication traits are influence behaviors including ICT selection. For example, the argumentative communication trait is associated with the tendency to advocate positions on controversial issues and verbally attack other positions. Argumentative individuals perceive arguing as intellectually exciting and competitive (Infante et al. 1982). Argumentativeness is not considered an unfavorable trait and is thought to improve learning help see other's points of view, enhance credibility and build communication skills (Littlejohn et al. 2005). Research has linked argumentativeness to assertiveness,

but not all assertive individuals are argumentative (Littlejohn et al. 2005; McCroskey 1998).

Given the predisposition toward communication and vigorous exchange of ideas, it is hypothesized that a positive relation will exist between the argumentative trait and the communication capabilities of velocity and parallelism. (See Table 3 for a summary of all hypotheses.).

H1: The communication capability velocity will be positively related to the argumentative trait.

H2: The communication capability of parallelism will be positively related to the argumentative trait.

Communication apprehension is described "an individual's level of fear or anxiety associated with either real or anticipated communication with another person or persons" (McCroskey 1984). Individuals with a high communication apprehension trait tend to avoid communication, experience discomfort in social situations and suffer from negative thoughts regarding the act of communicating (Littlejohn et al. 2005; Patterson et al. 1997).

It is hypothesized that there will be a negative relationship between communication apprehension and both velocity and parallelism since individuals who avoid

communication would show a lower preference for capabilities that increase the rate or volume of interaction. In addition, it is anticipated that there will be a positive relationship between communication apprehension and rehearsability. Individuals apprehensive about communicating and plagued by negative thoughts of regarding the consequences of communication are expected to prefer a capability that allows them to rehearse before communicating.

H3: The communication capability of velocity will be negatively related to the apprehensive communication trait.

H4: The communication capability of parallelism will be negatively related to the apprehensive communication trait.

H5: The communication capability of rehearsability will be positively related to the apprehensive communication trait.

An animated communicator is described as one providing sustained eye contact, many facial expressions, numerous gestures and other nonverbal cues (Norton 1983). Animated communicators readily convey emotions and moods though expression and theatrical emphasis to punctuate meaning.(Cassell et al. 1999; Norton 1983). It is expected that animated individuals will prefer technology capabilities that allow them a rich and diverse symbol set for expressing and emphasizing messages. Given these

attributes, it is hypothesized that a positive relationship will exist between the animated communicator trait and symbol variety.

H6: The communication capability of symbol variety will be positively related to the animated communication trait.

Wit is viewed as a communication trait that involves the creation of humor in social settings. Wit can be used as a means of disparaging self or others in an attempt to ease embarrassment or mitigate the aggressiveness of others (Duran 1983; Stocking et al. 1976). The incongruity theory of humor posits that humor is generated by the expression of the unexpected, surprising, or absurd (Berger 1976; Berger 1993; Veatch 1998). It is hypothesized that wit will be positively related to symbol variety since witty individuals are expected to use the variety provided by a large symbol set to aid in expressing surprising or absurd messages.

H7: The communication capability of symbol variety will be positively related to the witty communication trait.

Articulation is defined as the manner of communication that produces messages which are grammatically correct, properly structured, and well organized (Duran 1983; Perkins 1977). It is hypothesized that articulation will have a positive relationship to rehearsability and reprocessability. The rationale being that highly articulate individuals

will place emphasis on crafting and rehearsing messages and reviewing messages of others with a high degree of precision.

H8: The communication capability of rehearsability will be positively related to the communication trait of articulation.

H9: The communication capability of reprocessability will be positively related to the communication trait of articulation.

Table 3: Hypotheses

		Individual Communication Trait				
Media Capability		Argumentative	Apprehensive (Group Communication)	Animated	Witty	Articulate
		+	-		+	
	Velocity					
	Symbol Variety			+	+	
	Parallelism	+	-			
	Rehearsability		+			+
	Reprocessability					+

Methodology

To test the hypothesized relationship between communication traits and media capabilities, a survey was developed. The communication traits--argumentative (Infante et al. 1982) , apprehensive (McCroskey 1977; McCroskey 1984), animated (Duran 1983), and articulate (Duran 1983)—where drawn from existing measures in communications research.

To develop the media capability preference portion of the survey, a set of items were created to measure individual preferences for technology capabilities (feedback/velocity, symbol variety, rehearsability, reprocessability, parallelism, and discretion). The final instrument included the traits from the second pilot along with computer self-efficacy and demographic items for a total of 76 questions. Additional detail on the development of the instrument is given in Chapter 3. The survey instrument is included in Appendix A. Table 4 provides the Cronbach Alphas obtained for each of the factors used in this study.

Table 4: Reliability Statistics

Reliability Statistics		
Factor	Alpha	N of Items
Velocity	0.728	3
Symbol Variety	0.84	6
Parallelism	0.893	6
Rehearsability	0.859	6
Reprocessability	0.869	4
Argumentativeness	0.915	10
Group Comm Apprehension	0.892	6
Animated	0.686	4
Wit	0.767	5
Articulation	0.852	5

Several populations were used for this study. The two larges populations consisted of participants from a large media conglomerate and a wireless communication provider. In addition, a general population of managers and knowledge workers was included. One-way analysis of variance (ANOVA) indicated that while these populations were no equal with respect to computer expertise, age, or frequency of communications technology use,

the populations were showed these differences does not play a significant role in our research model. That is, age and organizational culture does not significantly bias the participant's self-described communication traits or preferences for communication technologies. Table 5 below provides a summary of key measures of the overall population.

Table 5: Select Sample Statistics

	Percent of Total Sample
Age	
18-24	10.9
25-30	9.8
30-39	30.4
40-49	29.1
50-59	15.6
60+	4.2
Computer Experience	
Advanced	62
Intermediate	36
Beginner	1.7
No Experience	0.3
Industry	
High Tech/Info Systems	28.5
Entertainment/Media	20.5
Manufacturing	5.3
Retail	5.3
Healthcare	5.8
Education	2.5
Finance	2.8
Real Estate	0.3
Other	29.1

Results and Discussion

To explore the underlying structure of the communication capability factors included in this research, factor analysis was performed. However, prior to conducting factor analysis, Bartlett's Test for Sphericity and the Kaiser-Meyer-Olkin (KMP measure of sampling adequacy) were performed. Bartlett's test yielded a significance of .000 and

KMO yielded a .869, well above the threshold of .6 suggested for a good factor analysis (Tabachnick & Fidelll 2007).

Factor analysis was performed using principle component analysis (PCA) with Oblimin rotation and Kaiser Normalization. This analysis indicated five underlying factors being measured by the communication capabilities items, as expected. This is represented in Table 6 and Table 7.

Table 6: Eigenvalues and Total Variance Explained

	Initial Eigenvalues		
Component	**Total**	**% of Variance**	**Cumulative %**
1	6.401	25.604	25.604
2	5.038	20.154	45.758
3	2.153	8.614	54.371
4	1.506	6.024	60.396
5	1.008	4.032	64.427
6	0.868	3.471	67.898
7	0.812	3.248	71.146
8	0.727	2.909	74.056
9	0.645	2.58	76.635
10	0.589	2.357	78.992
11	0.57	2.278	81.27
12	0.525	2.101	83.371
13	0.498	1.992	85.363
14	0.45	1.799	87.162
15	0.438	1.75	88.912
16	0.414	1.655	90.567
17	0.374	1.496	92.063
18	0.354	1.414	93.477
19	0.326	1.304	94.781
20	0.275	1.099	95.88
21	0.248	0.993	96.873
22	0.238	0.953	97.827
23	0.213	0.854	98.681
24	0.175	0.699	99.38
25	0.155	0.62	100

Table 7: Factor Loadings and Structure Matrix for Principle Component Analysis

	Structure Matrix Component				
	1	2	3	4	5
Velocity4	0.528	-0.007	-0.495	-0.206	0.704
Velocity5	0.308	-0.235	-0.279	0.111	0.795
Velocity6	0.428	-0.103	-0.37	0.001	0.784
Symbol Variety1	0.098	0.156	-0.688	-0.102	0.112
Symbol Variety2	0.163	0.123	-0.771	-0.072	0.276
Symbol Variety3	0.291	-0.035	-0.798	-0.143	0.287
Symbol Variety4	0.386	0.006	-0.848	-0.157	0.383
Symbol Variety5	0.359	0.115	-0.753	-0.165	0.409
Symbol Variety6	0.353	-0.1	-0.613	-0.257	0.331
Parallelism1	0.768	0.017	-0.271	0.073	0.355
Parallelism2	0.735	-0.073	-0.166	0.24	0.23
Parallelism3	0.798	-0.092	-0.331	-0.157	0.454
Parallelism4	0.883	-0.098	-0.34	-0.142	0.33
Parallelism5	0.815	-0.075	-0.226	-0.237	0.283
Parallelism6	0.861	-0.142	-0.332	-0.183	0.431
Rehearsability1	-0.144	0.828	0.001	-0.217	-0.178
Rehearsability2	0.095	0.16	-0.215	-0.724	-0.029
Rehearsability3	0.002	0.813	-0.165	-0.269	-0.057
Rehearsability4	-0.066	0.826	-0.031	-0.183	-0.071
Rehearsability5	-0.098	0.85	-0.078	-0.219	-0.028
Rehearsability6	-0.128	0.824	-0.068	-0.314	-0.141
Reprocessability3	0.016	0.594	-0.047	-0.5	0.159
Reprocessability4	-0.035	0.392	-0.109	-0.648	0.196
Reprocessability5	0.056	0.639	-0.049	-0.67	0.079
Reprocessability6	0.059	0.293	-0.134	-0.755	-0.024

Bivariate Correlations using Spearman's correlation coefficients were used to test the hypotheses discussed earlier. The results are given below in Table 8.

Based on the Correlations given in Table 8, H1 (the velocity to argumentativeness relationship), H2 (the parallelism to argumentativeness relationship), H5 (the rehearsability to apprehensiveness trait), H6 (the symbol variety to animated

relationship), H7 (the symbol variety to wit relationship) are all supported with a medial degree of strength.

H3 (the velocity to apprehensiveness relationship) and H4 (the parallelism to apprehensiveness trait) are supported with high correlations between the communication trait and media capability. However, H8 and H9 are not supported as the correlations between articulation and rehearsability and reprocessability are small and insignificant. The hypothesized relationships are highlighted in bold in Table 8.

Table 8: Pearson Correlations

		Communication Traits				
		Argumentative	Apprehensive (Group Communication)	Animated	Wit	Articulation
Media Capabilities	Velocity	**.397****	**-.570****	.398**	**.213****	.158**
	Symbol Variety	.341**	-.354**	**.363****	**.300****	.107*
	Parallelism	**.411****	**-.490****	.237**	.182**	0.052
	Rehearsability	-0.038	**.228****	0.06	0.087	**-0.098**
	Reprocessability	0.07	-0.059	.253**	0.083	**0.089**

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Discussion

While most of the hypotheses set forth in this study were validated, there are some additional interesting findings. First, the group communication apprehensive trait is significantly correlated with all media capabilities except reprocessability. Negative relationships exist between the apprehensive trait and all capabilities except rehearsability. A positive correlation between the apprehensive trait and rehearsability was hypothesized since individuals experience anxiety over communication may have a higher preference for technologies that allow practicing a message prior to communicating it. In addition, correlations of medium strength exist between symbol variety and both argumentativeness (positive) and group communication apprehensiveness (negative). This could be an indicator that symbol variety capabilities appeal to a wide range of communication traits (with the exception of apprehensive communicators). In other words, symbol variety may be one of the most important capabilities to account when providing a mix of communications technologies to knowledge workers. While other significant correlations exist between communication traits and media capabilities outside of the hypothesized relationships, the strength of these correlations is relatively small and could be influenced by the large sample size.

Though this study is unique in exploration of individual communication traits and technology preferences, several limitations exist. First, there are many different communication traits that have been researched in the communications field. In addition to those explored in this study, there are numerous other communication traits that are potentially valid and may be worth studying. In other words, the traits in this study are

by no means comprehensive or exhaustive. Another limitation of this study arises from the number of items needed to measure the factors under consideration; the survey was quite lengthy and additional demographic variables were not included. However, additional demographic variables, such as gender or ethnicity, may play a moderating role in the relationship between communication traits and media capability preferences.

This study is significant because it is among the few to explore the role of individual communication traits as they relate to media selection. In addition, it is the first to explore individual traits within the lens of Media Synchronicity Theory and thereby extends the current understanding of how the communication style of the individual mediates the relationship between technology capabilities and actual use. This study also introduces an instrument for examining salient media traits independent of technology. From a practitioner standpoint, this research offers a way in which knowledge workers can more effectively manage numerous communication options and avoid information overload. Also, technology designers can better optimize the mix of technologies made available to knowledge workers.

Chapter 2: Information and Communication Technologies: Adoption, Use, and Social Diffusion of Communication Norms

Introduction

A rapid increase in the use and variety of communication media available via the Internet has created unlimited reach and reachability for individuals with Internet access. As the pathways for interconnectivity between individuals has increased, there has been a great deal of discussion regarding the influence of technology-enabled communication on the spread of communication norms. The increase in adoption of email and Internet access at home and work has led many organizations to shift expectations regarding communication responsiveness. In many corporate cultures workers are expected to respond to email or be reachable by cell phone beyond traditional work hours an in some cases even during vacation time. As more workers began using new technologies, the communication norms of these individuals began to impact expectations on communication norms for all workers.

Communication media serve as the pathways for knowledge flows within organization. Knowledge workers not only exchange explicit knowledge via ICTs, but also convey tacit knowledge in communication regarding policies, routines and corporate culture (Alavi 2001). Researchers suggest that the properties of utilized communication channels

impact the spread of norms within organizations (Gupta 2000). Information and Communication Technologies enable the a range of possible interactions that can produce new and unexpected changes in communication norms For example, managers may inadvertently change organizational communication norms when declaring a new mode of communication (e.g. email) the official channel for certain types of interaction (Orlikowski et al. 1994). In addition, researchers have began looking at how ICTs impact self-disclosure, expressiveness, and other communication behaviors thought to be heavily influenced by norming processes (Joinson 2001) (Tidwell et al. 2002).

As individuals interact with colleagues within and across the organization, they influence one another's perspective and mental model of organizational norms. Thus, an individual's communication style is in part made of communication norms that are shaped by interaction with others. Shared communication norms provide a foundation for the emergence of mutual understanding. As shared understanding emerges, the redundancy of information within the organization allows for greater connectivity between individuals. This overlapping of perspectives provides a foundation for improved collaboration and provides a competitive advantage through improved efficiency (Alavi) and innovativeness (Grossman and Helpman 1991).

Information and Communication Technologies (ICTs) are in a unique position to impact the spread of norms within organizations as they provide additional pathways for the interconnectivity and knowledge flow across traditional boundaries. This research is

aimed at understanding how Information and Communication Technologies (ICTs) impact the spread of communication norms within organizations.

There are a number of models that broadly describe emergence of shared norms, and for this research I adopt Axelrod's model of "culture" as a vehicle for conceptualizing norms, specifically communication norms. This model defines communication norms as "language, attitudes, behaviors" (Axelrod 1997) and other verbal and nonverbal attributes that people learn from one another in the practice of communication.. Thus, each individual has certain verbal and nonverbal characteristics that are subject to influence and change through interaction with others.

This chapter will extend Axelrod's Culture Model (ACM) to examine the effects of new communications technologies in disseminating communication norms. The methodology used in this research is simulation that provides an extension to original ACM which investigates the role of ICT use.

The remainder of this chapter is organized as follows. First, relevant theories are discussed and the research hypotheses are provided. Next is a description of the algorithm and underlying assumptions for the simulation given, and the chapter concludes with a discussion of the results and implications.

Relevant Theory

This chapter includes a discussion of two bodies of theory, Adaptive Structuration Theory and Media Theory, which are merged to form the theoretical basis for this research. Relevant empirical findings from these theories underlie the assumptions used in the proposed model.

Adaptive Structuration and Norms

Adaptive Structuration Theory provides the most comprehensive theoretical lens for framing the interplay between technology and social structures. It posits that technology and social behavior mutually shape one another and are intertwined in a recursive relationship. According to AST, new norms in group interaction can emerge as communication technologies are appropriated (DeSanctis et al. 1994b).

Information and communication technologies enable and constrain interaction in the workplace through support of coordination and communication while providing procedures for interpersonal exchange (DeSanctis et al. 1994b). The process by which technology impacts norms can be thought of in two stages: 1) norms are projected electronically and 2) norms are transferred between individuals electronically. A number of studies indicate that individuals project personal styles, previous experience and norms via electronic communication (Weisband et al. 1995; Wilkins 1991). Thus, the act of communicating signals to the receiver tacit information about the sender's perspective on acceptable behavior. ICTs provide a space for creating and sharing beliefs and testing the

social validity by confirming mutual interpretation (Henderson and Sussman 1997). Repeated interactions serve as a mechanism for creating and transferring norms among individuals. Overtime, new norms emerge as individuals blend and converge on shared perspectives.

On the other side of the technology-norm relationship, trends in ICT usage are thought to be affected by social conditions (Abel 1990), (Lea 1992). Firms that foster a collaborative environment and provide incentives for individuals to share knowledge directly and indirectly encourage the use of ICTs (Serenko et al. 2007). The reciprocal relationship where norms influence electronic communication has also been examined empirically (Ferrara et al. 1991). Thus, technology provides a vehicle to create and transfer norms, but existing norms provide a context that influences the use of ICTs.

As the use of ICTs becomes more widespread, new communities with differing perspectives and norms are likely to emerge within and outside of existing organizations and communities (DeSanctis et al. 1999b). Individual identification is thought to be impacted by ICTs (Wiesenfeld et al. 1999). It follows that if an individual's attitudes, beliefs and style can be affected, then norms are influenced by the use of ICTs. These norms in turn influence message interpretation and response, and it has been suggested that normative context may be even more important in computer-mediated communication (DeSanctis et al. 1999b). Other research has shown that groups separated by physical distance can become very cohesive and electronic interaction begins to mirror the interactional effects of a social community (Abel 1990; Wilkins 1991).

Within organizations ICTs facilitate boundary spanning (DeSanctis et al. 1999b) so that culturally and functionally diverse parties have the opportunity to interact and exchange ideas. Organizations develop routines and accepted practices for the use of information and communication technologies. The practices make up the norms for individuals within the organization, and these norms, once disseminated, influence individuals in distinct groups within the organization as they interact across traditional boundary lines. For example, an employee in the sales division at location may use social networking to foster relationships with a client base. Likewise, an individual in Marketing may use RSS feeds to collect and broadcast information on changes in the industry. As these two individuals interact, they are likely to exchange information using various media. To the extent that their interests or informational needs are similar, the employees are likely to adapt norms of behavior including the use of ICTs from one another. This exchange and influence of norms can take place repeatedly as new communications technologies are introduced and new interactions occur.

ICTs and Communication Patterns

Watson-Manheim suggested that employees develop "communication repertoires" and that the selection of ICTs may vary between communities and organizations due to different communication purposes and institutional and situational conditions (Watson-Manheim et al. 2007). In addition, it has been suggested that individuals select sequential and concurrent combinations of ICTs to achieve communication goals such as message acknowledgement, enhancement of mutual understanding, and participation in

multiple communication interactions (Bélanger et al. 2006). The shift in emphasis from single communication media selection to multiple media selection is thought to be influenced by the rise of more distributed work environments (Woerner et al. 2004).

With an increasing array of information and communications technologies available to knowledge workers, researchers have began to ponder how off-line social networks are impacted by the increase in computer-mediated communication (Lampe et al. 2006). One premise, the "hydraulic effect," suggests that as the repertoire of communications technologies increases, individuals will rely more on electronic communication rather than face-to-face communication. In other words, increasing use of ICTs begins to replace face-to-face communication. This premise becomes more intuitive if one considers total time spent communicating. Time spent writing and responding to email, generating text messages, and using social media has the potential to displace time spent in traditional face-to-face conversation assuming that the amount of hours that a worker can spend communicating is relatively fixed. Recent studies support this theory finding that addition of e-mail to an individual's repertoire of communication techniques decreased the likelihood of face-to-face communication and "in-person visits (Kraut et al. 1998; Shklovski et al. 2004) (Nie et al. 2002). One study found this effect most pronounced for the heaviest electronic communicators with the probability of a face-to-face visit dropping from 70% to 49%. At the same time individuals who did not use electronic communication experienced no changes in the likelihood of face-to-face communication (Shklovski et al. 2004). The Schlovski and Kraut longitudinal studies are

significant because they demonstrate causality between increased electronic communication and decreased face-to-face communication.

The complexity of the technology-action relationship (DeSanctis et al. 1994b) as individuals rely on increasing repertoires of technology (Watson-Manheim et al. 2007) to communicate, and are in turn influenced by changes in norms, is being modeled in the research. To explore the relationship between increasing electronic communication and the spread of norms, an extension to Axelrod's Culture Model was created. Axelrod's Culture Model encapsulates the premise that agents who have similar attributes are more likely to interact with each other. Through interaction these agents exchange ideas and new patterns of shared "cultures," or perspectives begin to emerge on a collective level (Axelrod 1997).

Axelrod's Culture Model has been widely applied and extended. Shibinai, et al extended Axelrod's research by suggesting the existence of a fifth agent used to model mass media. Their research measured the effects on size and number of cultures if this fifth agent was treated as an omnipresent influencer of agents (Shibinai et al 2001). Greig's extension to Axelrod's model gave agents the ability to communicate over larger ranges and simulated the effects of global communication (Greig 2002). This research differs from Greig's extension in that access to global communication is unevenly distributed. Also, Greig's extension allowed all agents to communicate at progressively larger distances, essentially enlarging the size of the neighborhood surrounding an agent. Kennedy extended Axelrod's model to illustrate social interaction resulting in optimized

cognition (Kennedy 1998). Parisi et al revisit Axelrod's model to show how cultural assimilation may take place even between sites with zero similarity (Parisi et al 2003). In another work, Castellano, et al performed numerical simulations of Axelrod's model to apply concepts and methods of physics to analyze findings in social sciences research (Castellano 2000).

This research extends Axelrod's model to measures the impact of increase use of ICTs (versus face-to-face communication) on the spread of norms.

In this study electronic communication is being modeled as the ability to reach and interact with any other agent also using electronic communication. This is different from Axelrod's model in which agents could only interact with their nearest physical neighbors. In this study, the interaction with adjacent neighbors is used to represent face-to-face communication, and the ability to reach any individual is being used to represent the mechanism of electronic communication.

Approach

A simulation is being used to explore the relationship between use of ICTS and the spread of communication norms within organizations. Specifically, an extension to Axelrod's Culture model was created. This research extends Axelrod's model to measure the effects of use of ICTs on *R*, the velocity of spread of norms, *S*, the size of the largest norm group, and *D*, the diversity of norms in the overall population. In this study, the use of ICTs is being modeled as the ability to reach and interact with any other agent also using ICTs.

The model used in this research consists of a lattice representing a population of *I* agents or individuals. For each agent *i* there is a norm state vector (V_{1i}, $V_{2i,}...V_{3F}$), which consists of *F* features and with each feature taking on T traits such that $V \in [0, \ldots, T\text{-}1]$, where *T* is the number of possible trait values (set assumed equivalent for each trait and agent). Features can be thought of as categories of malleable mental concepts possessed by each individual. Traits are the various values of information that a feature can take on. As the agents interact, information is exchanged and new concepts emerge and are reflected in the norm state vector. The complexity of the population is captured in the length of *F*, so more complex populations would have more norm characteristics and therefore a longer *F* vector. In a similar fashion the greater the q, or number of traits for the population, the greater the heterogeneity of norms in the society (Blau et al. 1984; Centola et al. 2007).

Initially, the traits T are randomly and independently assigned with an equal probability of 1/T. There are I agents on a two dimensional lattice with Moore neighborhoods (each agent is surrounded by a grid of 8 other agents that are its neighbors) (Atran et al. 2007) (Centola et al. 2005). See Figure 5. In the current extension to the model, a subset T of the population of I agents is given access to ICTs that enables an agent to interact with another agent beyond its Moore neighborhood if that agent also has access to ICTs. For agents using ICTs there is a parameter C_v that specifies the ratio of ICT communication to local communication.

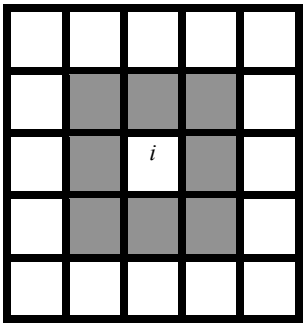
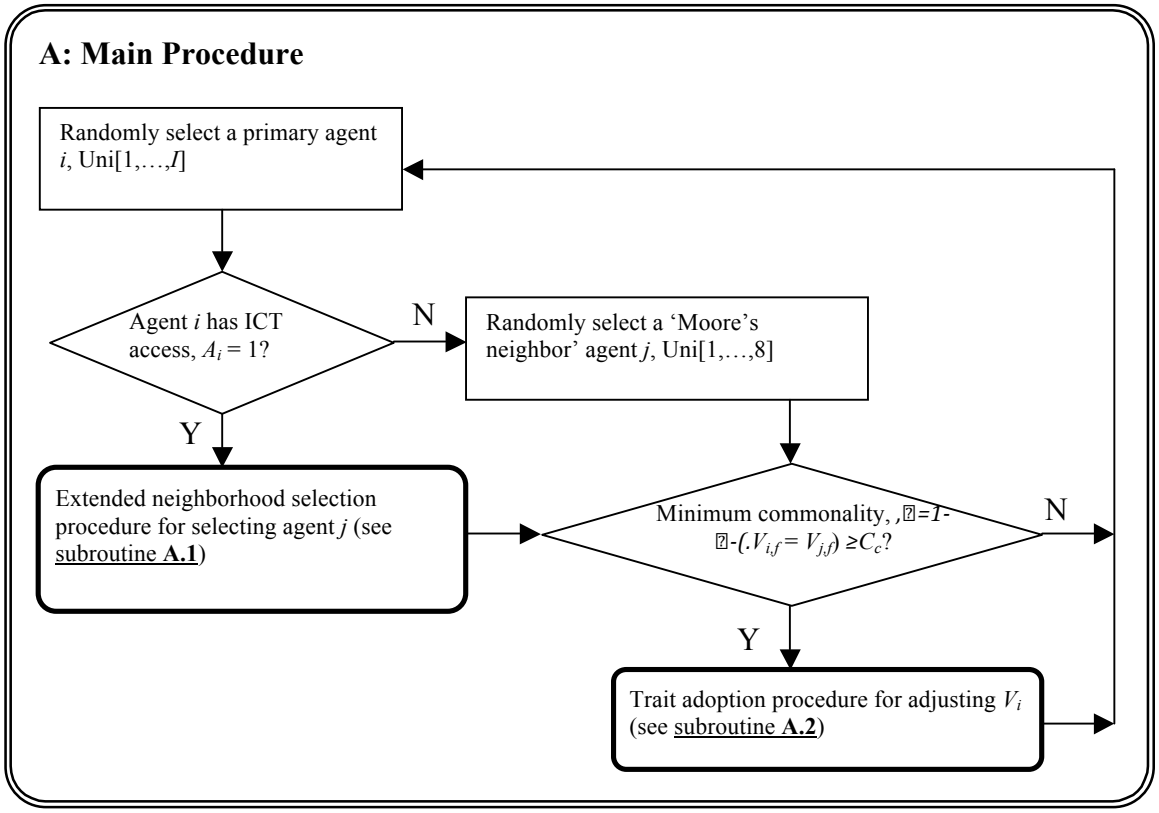
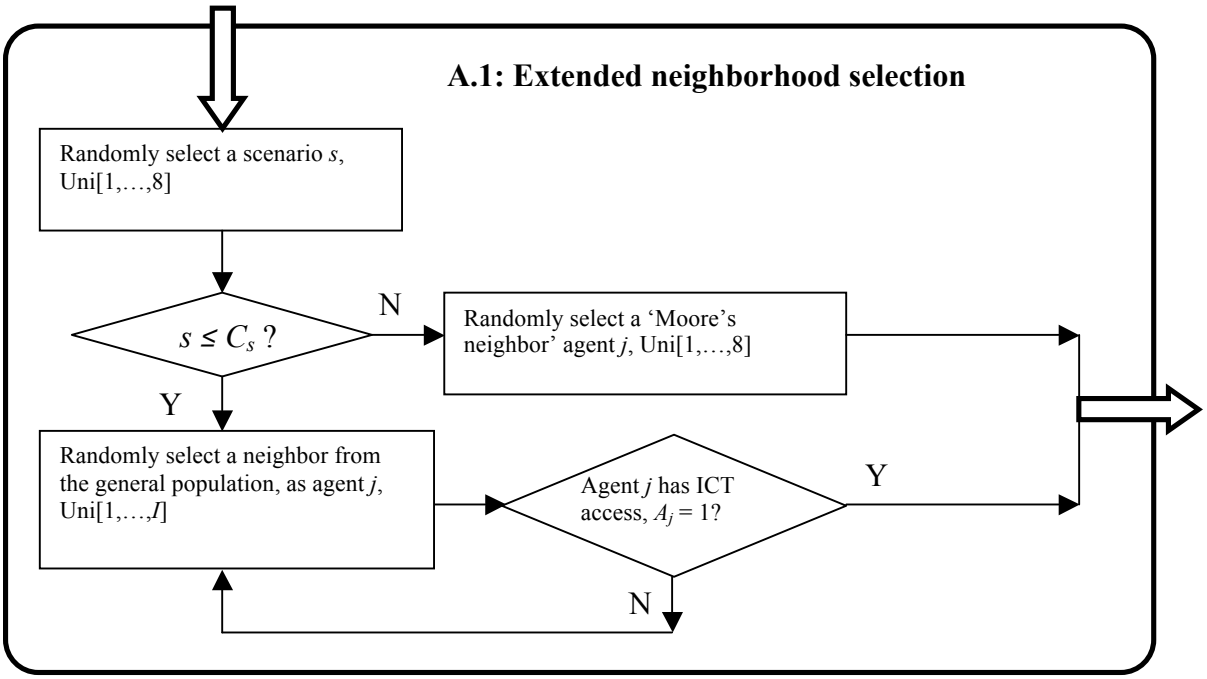


Figure 5: Moore's neighbors.
The shaded regions make up the Moore Neighborhood for the active agent, i

To simulate the socialization and externalization processes among individuals, an agent with the lattice selects either a random Moore neighbor or remote neighbor to exchange information with. This exchange of information results in a sharing of norms if enough similarity exists between the knowledge states of the two agents. Sharing of norms is reflected when one agent replaces the value in one of its features to match that of the other agent. A diagram of the algorithm is given in Figure 6.


A: Main Procedure
Randomly select a primary agent i, Uni[1,…,I]
Agent i has ICT access, A_i = 1?
N
Randomly select a 'Moore's neighbor' agent j, Uni[1,…,8]
Y
Extended neighborhood selection procedure for selecting agent j (see subroutine **A.1**)
Minimum commonality, ω=1-Ω-($V_{i,f}$= $V_{j,f}$) ≥C_c?
N
Y
Trait adoption procedure for adjusting V_i (see subroutine **A.2**)


A.1: Extended neighborhood selection
Randomly select a scenario s, Uni[1,…,8]
$s \leq C_s$?
N
Randomly select a 'Moore's neighbor' agent j, Uni[1,…,8]
Y
Randomly select a neighbor from the general population, as agent j, Uni[1,…,I]
Agent j has ICT access, A_j = 1?
Y
N

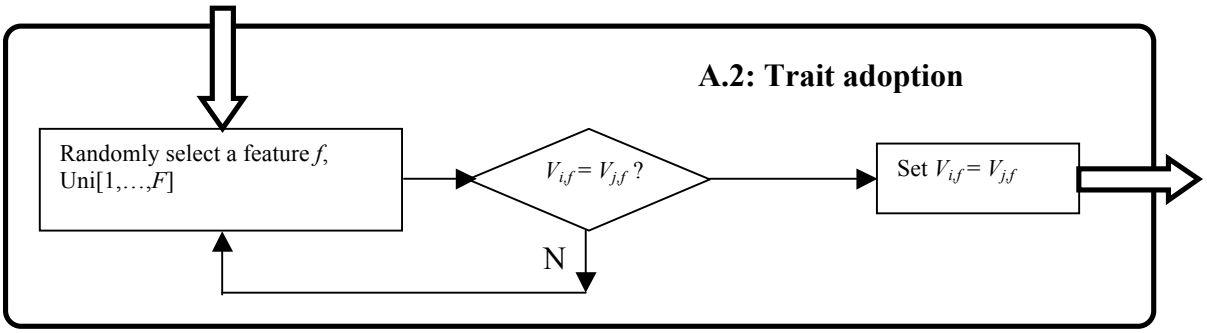


Figure 6: ICT and Communication Norms Algorithm

The algorithm described above is repeated with each round, and norms are diffused among the agents. At the organizational level, patterns of norms begin to emerge among the agents as the traits in the norm state vectors shift. See Figures 7 and 8.

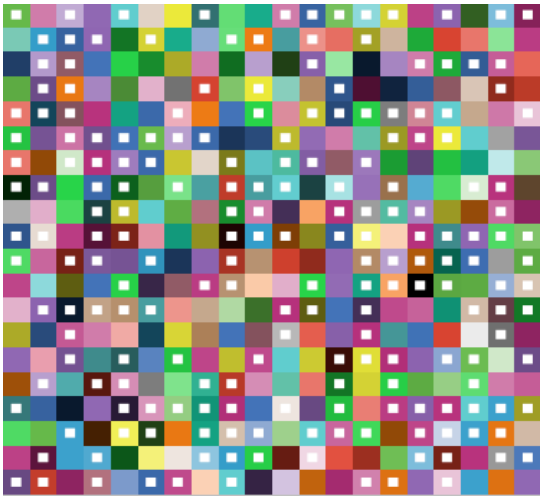


Figure 7: Initial State
Many norms are present. Note: Each square in the lattice represents an agent with a norm state vector. The white dots indicate agents with ICTs

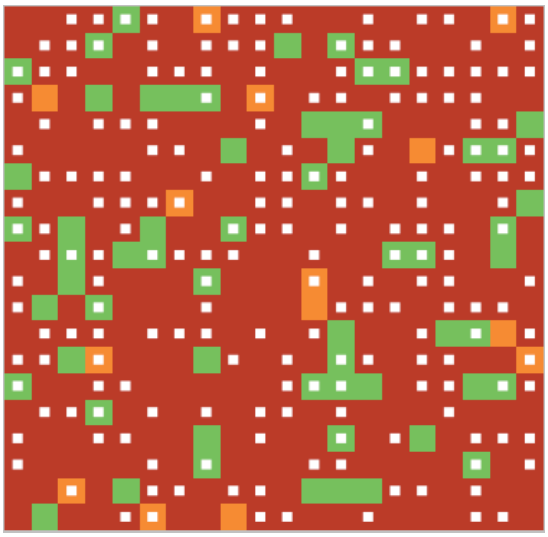


Figure 8: Equilibrium State
Fewer norms are present. Note: Each square in the lattice represents an agent with a norm state vector. The white dots indicate agents with ICTs

In summary, the rules governing interaction of the agents are as follows:

1. Select at random one agent to be the active agent *i*.
2. If the agent *i* does not have access, then it will randomly select one of its Moore neighbors as its partner *j*.
3. If the agent is of the population subset p_{ICT} (i.e. access to ICTs), it will choose either a Moore neighbor or remote neighbor also from the population subset T to be its partner. The probability that a remote neighbor will be chosen is C_v /8.
4. Determine the degree of similarity defined as the number of features that the two agents have in common or if $C_c=\sum_{f=1F} \delta V_{if,} V_{jf}$ is sufficient, thus, $0< C_c(i,j),F$.
5. If there is similarity between *i* and j, then they interact with the probability C_c (i,j)/F, and the agent *j* will change the value of one of its features at

random (where $V_{if,} \neq V_{jf}$) to match that of agent *i such that* $V_{if,} = V_{jf.}$ If the agents are identical, then no interaction will take place.

The independent variables in this study are the level of adoption of ICTs and the extent of ICT use. In this model, it is assumed that individuals have limited time to communicate and that communication with the use of ICTs displaces the face-to-face communication. The dependent variables in this study are velocity, size of the dominant norm (number of agents), and diversity. Velocity is measured as change in norms over time. More specifically, it is the change in the number of distinct norms from the start of the simulation until equilibrium is reached divided by the number of clock cycles until equilibrium is reached. The size of the dominant norm is the number of agents sharing the most common norm. Diversity is defined as the ratio of agents sharing the dominant norm to the total number of agents in the lattice. Diversity is reflected by the number of distinct norms existing among agents at equilibrium. Thus, the fewer the number of unique norms, the lower the diversity within an organization.

Hypotheses

The primary question being addressed by the current research is: How does the increasing reliance on electronic media in an individual's communication repertoire impact the spread of communication norms? The model under investigation in this research adopts the hydraulic effect and assumes that increased use of ICTs displaces time for face-to-face communication.

For this investigation, there are three independent variables: 1) The diversity of norms, 2) the velocity at which the norming process occurs, and 3) the size of the dominant norm. The velocity of the norming process is measured as change in the number of norms over the time take taken for the population to reach stable set of norms.

The independent variables are the degree of adoption of ICTs by the entire population. The hypotheses for this study are as follows:

H1: An increase in adoption of ICTs will result in an increase in the diversity of communication norms.

H2: An increase in adoption of ICTs will result in an increase in the velocity of communication norms.

H3: An increase in adoption of ICTs will result in an increase in the size of the dominant communication norm .

H4: The greater the use of ICTs, the greater the diversity of norms

H5: An increase in the use of ICTs will correspond to an increase in the velocity norms.

H6: An increase in the use of ICTs will correspond to a decrease in the size S of the dominant norm.

Research Method

The simulation was conducted on a 20x20 grid with wrapping edges such that all agents have eight neighbors. A larger grid was used to provide a greater opportunity to examine the effects of communication at distance. In addition, parameters for the number of features (5) and traits (10) were held in keeping with the original Axelrod model. The threshold for similarity was set at 20 percent to increase speed of interactions given the larger grid size. ICT Adoption was varied from 0 to 100 percent in increments of 10. ICT Usage was varied from 0 to 100 percent with each increasing level of ICT usage displacing more and more local communication. For each combination of parameters, 20 runs of the simulation where conducted for a total of 1000 clock cycles. All agents were randomly chosen (one at a time) to be the active agent *i* during each clock cycle. It was observed that system reached equilibrium in far fewer than 1000 clock cycles in most runs. Equilibrium was considered reached when no change in the number of cultures or change in the size of the dominant norm for 100 clock cycles or more. In the most extreme case, the system reached equilibrium at 843 runs. Beyond the point of equilibrium, agents may still interact, but the net number and composition of norms remains constant.

Results

As expected based on the original culture model, the number of unique norms declines exponentially over time and eventually stabilizes. In the experiment, the number of unique norms is stabilized by 300 clock cycles. However, varying the use and adoption

parameters changes the time of to reach stabilization of the rate of change of the number of norms. See Figures 9 and 10.

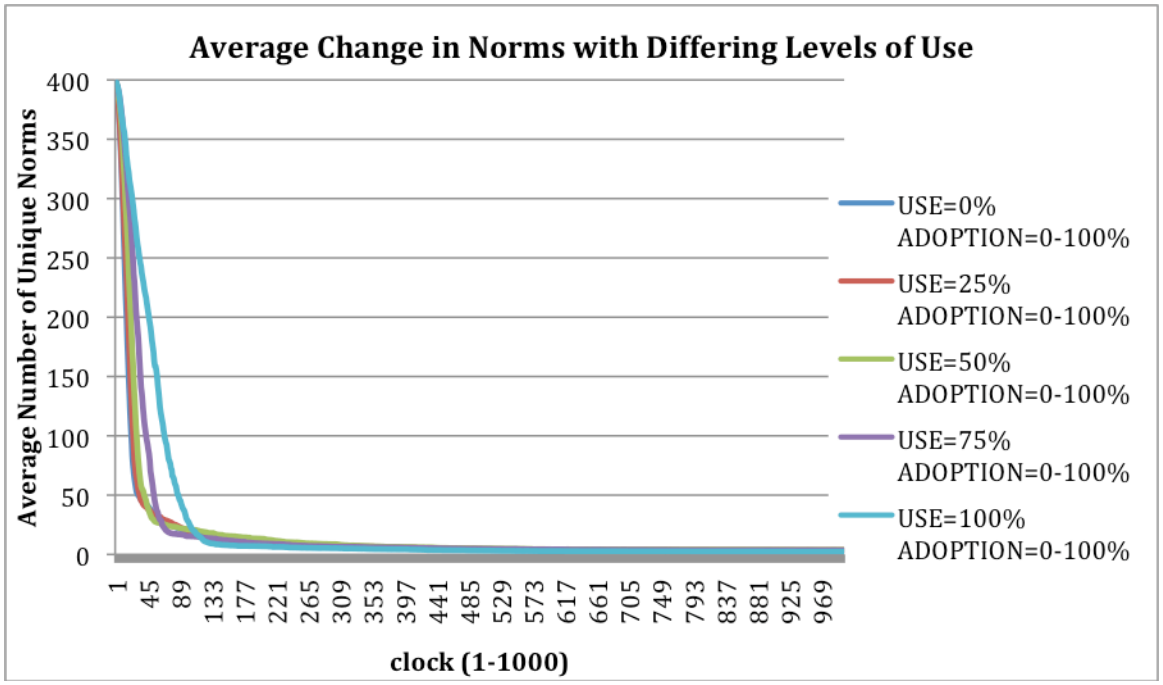


Figure 9: Average Change in Communication Norms with Differing Use

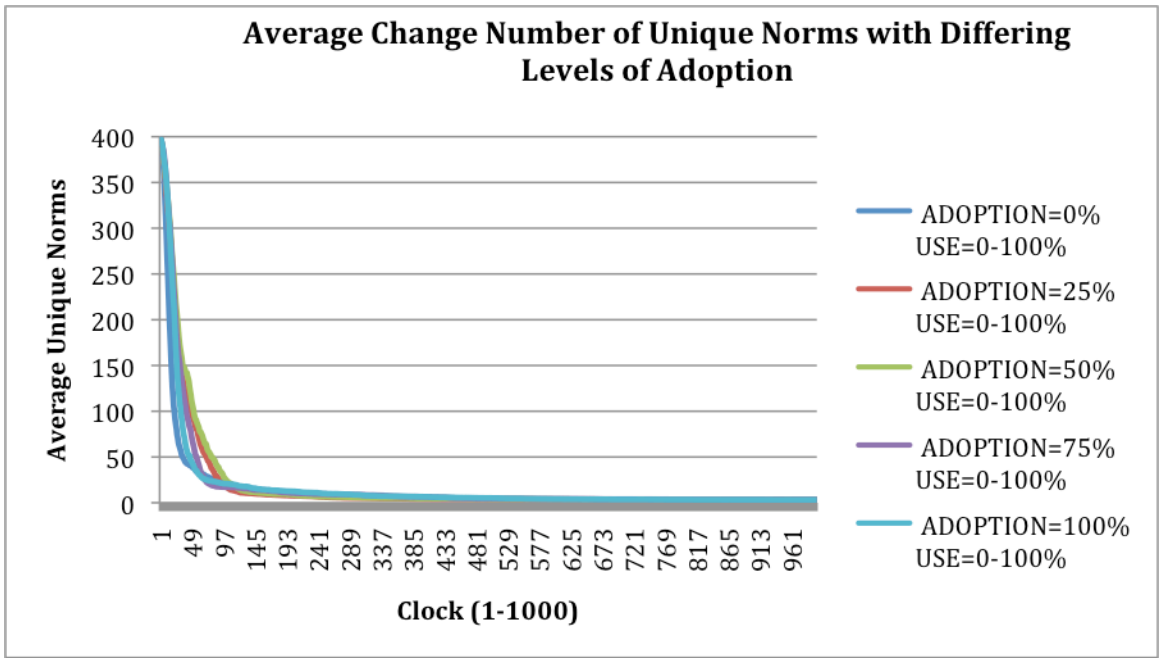


Figure 10: Average Change in Unique Communication Norms with Differing Adoption

A closer look at the variables of interest in this research yielded interesting and, in most cases, non-linear results. Increasing the use of ICTs for communication (with increasing displacement of local communication) has the effect of increasing the velocity, the speed at which norms are spread. However, the increase in velocity is not seen until higher levels of ICT usage and less local communication is present. Hypothesis 1a is supported for higher levels of ICT use. See Figure 11.

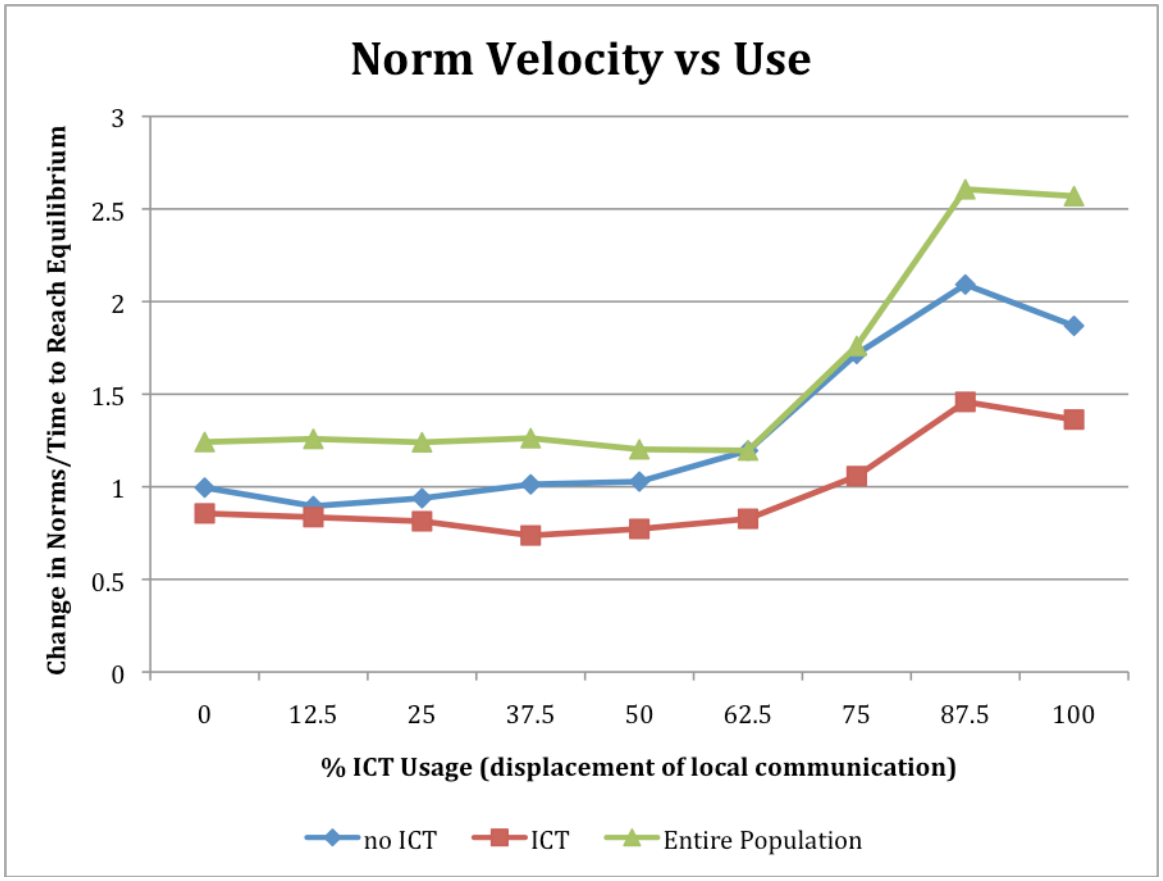


Figure 11: Velocity vs. Use

In general, as more of the population adopts ICTs for communication the velocity of decreases. However, there is a spike in velocity when ICTs are first introduced.
A one-way between group analysis of variance was conducted to explore the impact of ICT adoption on velocity. Two groups were compared: the agents with ICTs and the agents without ICTs. There was a statistically significant difference at the $p < .05$ level in velocity for the two groups; F (1 3,598) = 77.96, p = .0. The actual difference in mean vales was .336 with the ICT group have a mean velocity of .968 and the group with ICTs having a mean norm velocity of 1.304 when averaged across all levels of adoption and use.

Also of note is that the population with and without ICTs experience different velocity curves. The population without ICTs experiences a dramatic decrease in velocity beyond the initial spike resulting from introduction of the technology. The velocity of the population not using ICTs does not increase as dramatically, and beyond 50 percent adoption remains rather flat. Hypothesis 1b is supported as a small percentage of the population uses the ICT. However, H1b is not supported for greater adoption. See Figure 12.

A paired-sample t-test was conducted to evaluate the impact of the introducing ICTs to small portion of the population (10 percent level of adoption). There was statistically significant increase in the velocity of the change in norms from 0 percent adoption (mean = 1.32, standard deviation = 1.08) to 10 percent adoption (mean = 2.53, standard

deviation = 2.14), t(179) = -6.51, p< .0005 (two-tailed). The mean increase in velocity was 1.21 with a 95% confidence interval ranging from 1.579 to .084503.

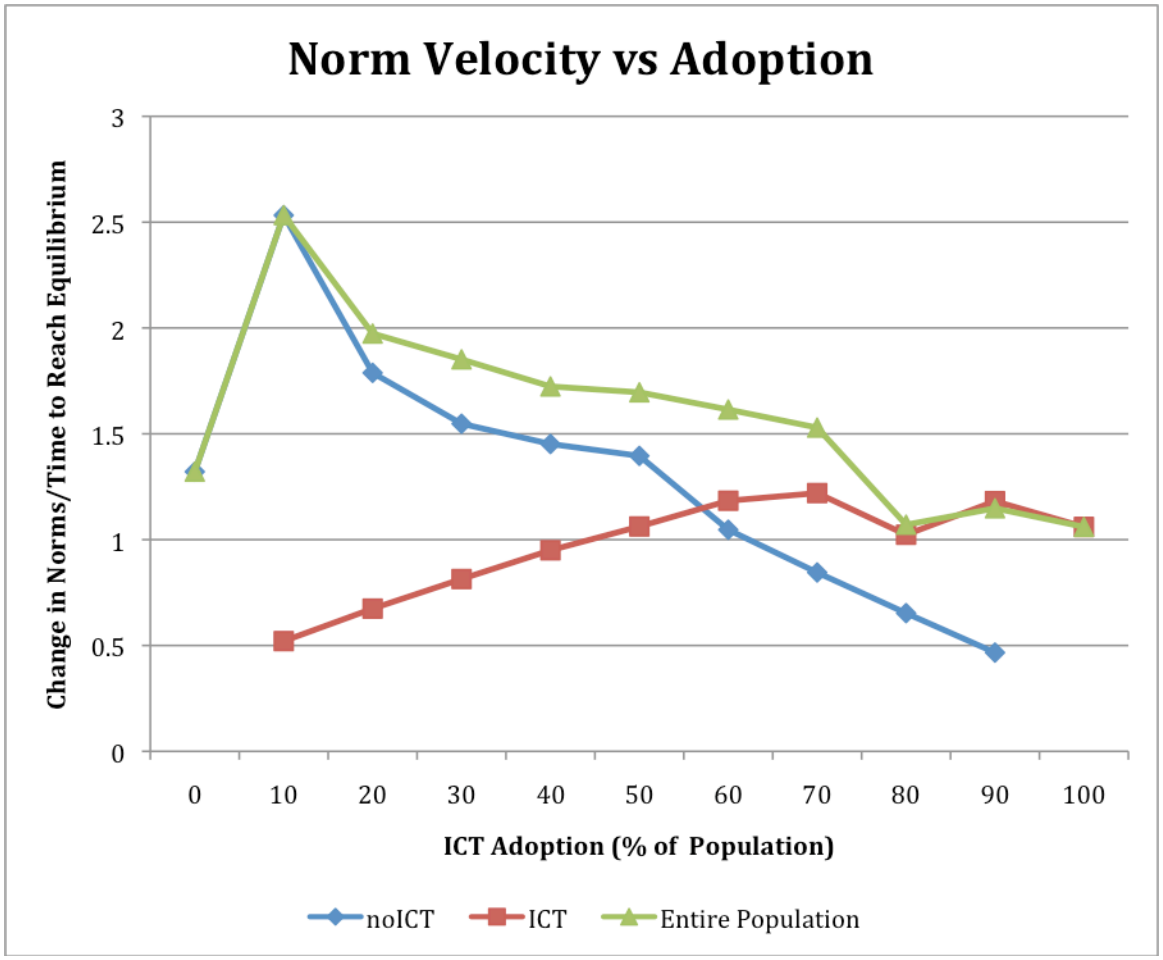


Figure 12: Velocity vs. Adoption

Increasing use of ICTs for communication (displacing local communication) had the effect of increasing the size of the dominant norm of the population. Thus, H2a was supported. See Figure 13. The effects of increasing adoption were less obvious. As with velocity, there is a dramatic rise in the size of the dominant norm of the population with the introduction of ICTs to a small portion of the population. However, the gains in

dominance quickly level out by the time a third of the population has adopted ICTs. As adoption increases beyond fifty percent, there is a slight decrease in the size of the dominant norm of the population. Given this, H2b is partially supported. See Figure 14. For both independent variables, there is no unique significant effect on redundancy between the population with ICTs and the population without ICTs.

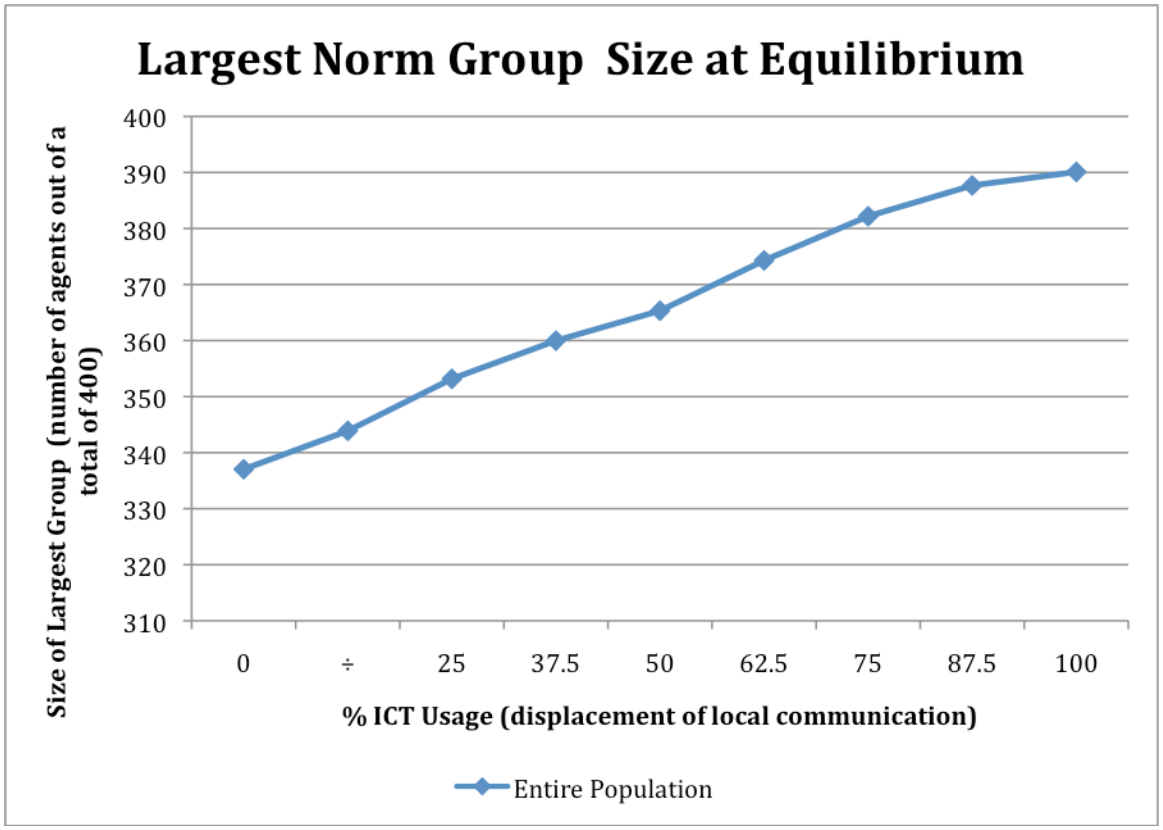


Figure 13: Size of Largest Norm Group at Equilibrium with Differing Use Levels

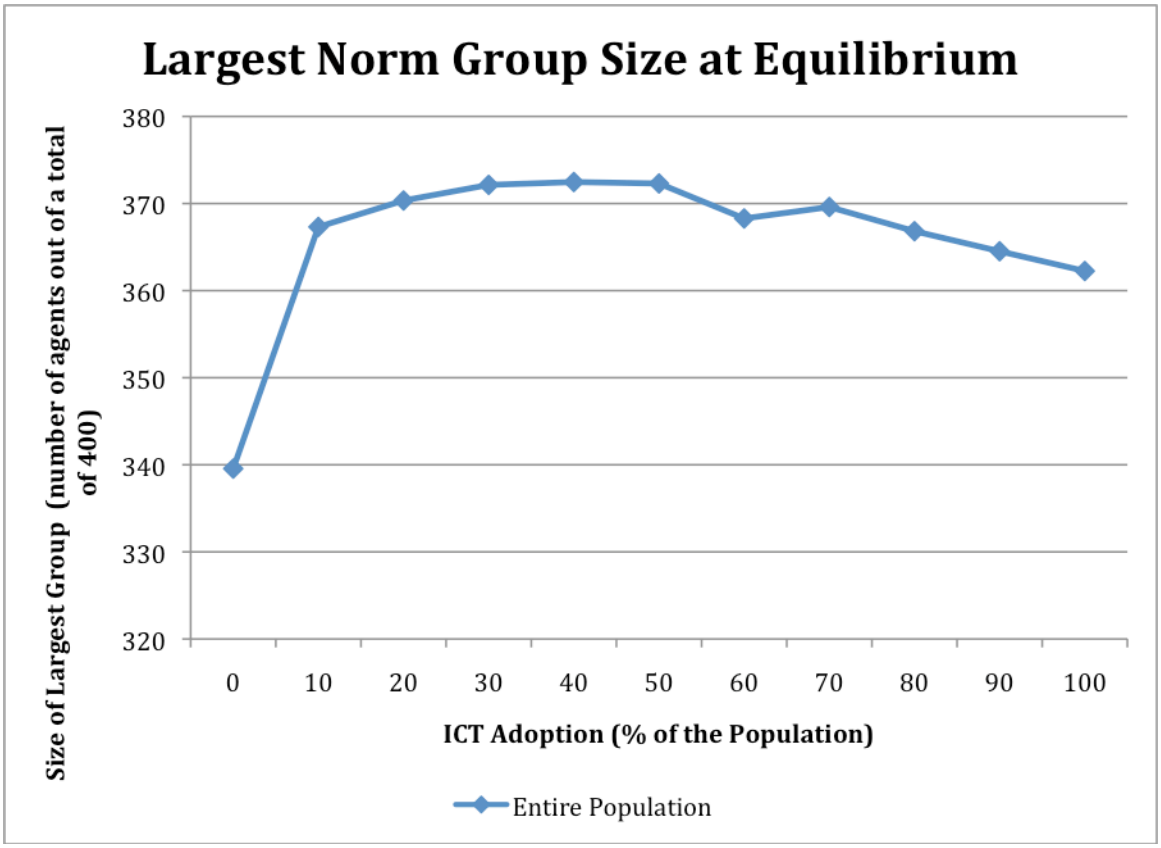


Figure 14: Size of Larges Norm Group at Equilibrium with Differing Adoption Levels

Diversity is shown to decrease with increasing use of ICTs as predicted by H3a. See Figure 15. Looking at the effects of adoption on Diversity, H3b is supported with the exception of at the earliest levels of ICT adoption. As seen with the other dependent variables, there is a spike between zero and 10 percent adoption. At lower levels of adoption, the number of communication norms actually increases and thus Diversity increases. See Figure 16.

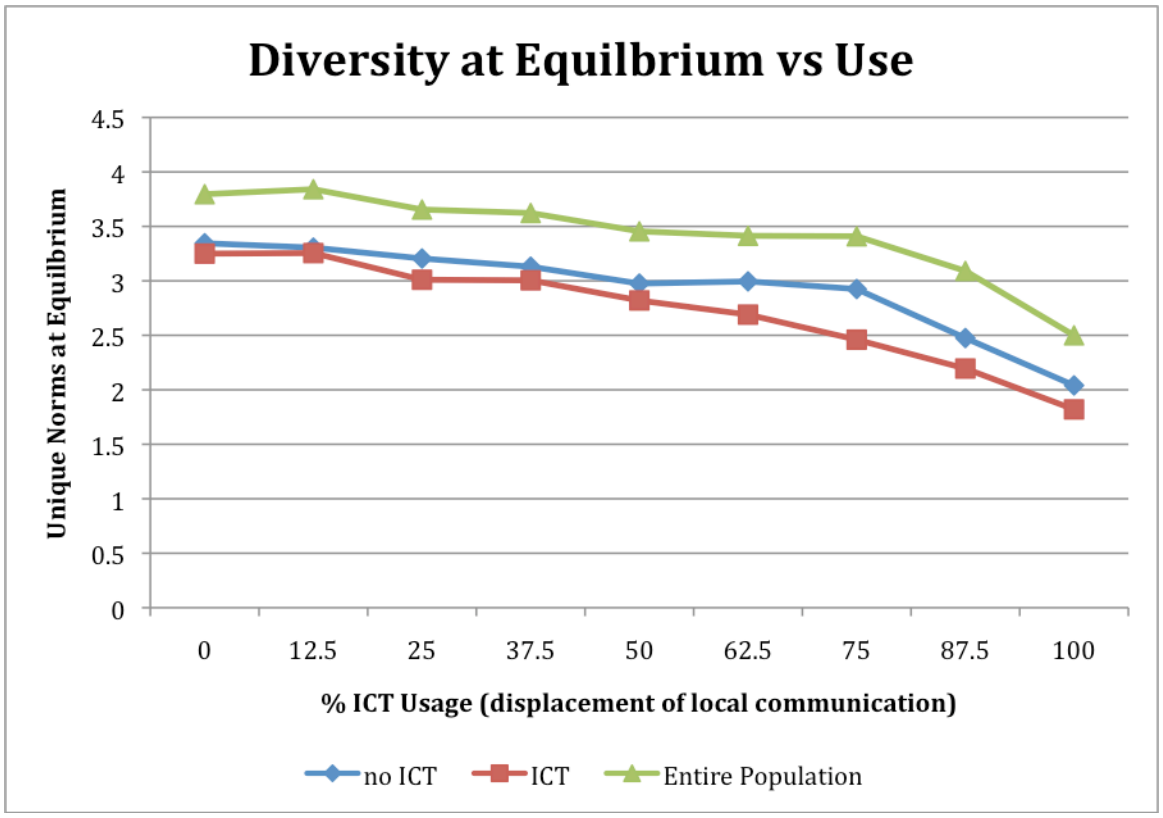


Figure 15: Diversity at Equilibrium vs. Use

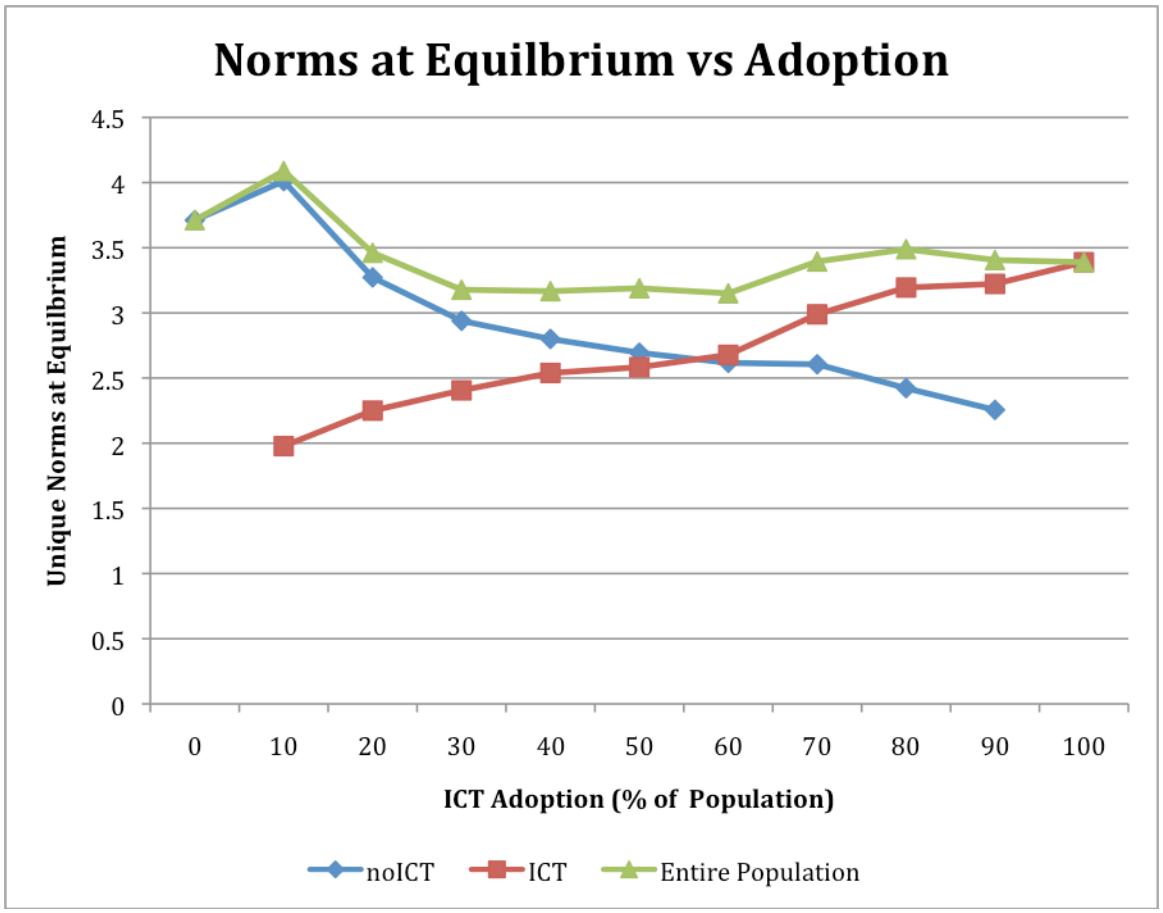


Figure 16: Diversity at Equilibrium vs. Adoption

To further validate the findings on velocity over time (refer to Figures 11 and 12), OLS regression was performed. Prior to undertaking regression analysis, a logarithmic transformation of the iteration axis (time in clock cycles) was conducted; the number of unique communication norms was scaled to a range of 0 to 1 and transformed such that the equation used for the regression was given by

$$Y' = B0 + B1\ X' \qquad \textbf{Eqn 1}$$

where

$$Y'=\ln((1-Y)/Y) \qquad \textbf{Eqn 2}$$

and where Y is the scaled number of unique norms, and

$$X' = \ln(t) \qquad \text{Eqn 3}$$

where t represents iterations or clock cycles.

These transformations highlighted a fairly strong linear relationship between the number of norms versus time, and the model yielded an R-squared of .85. In this analysis, velocity at the peak rate of convergence is given by the slope of the regression line, B1, and timing of the peak rate of norm convergence is given by the intercept term, B0. In terms of the graph, B1 is the steepness of the transformed curve.

Examining the B0 and B1 for aggregate data on use and adoption, it can be seen that both use and adoption are strong predictors of both the velocity change in communication norms and the peak rate at which those norms converge. This analysis provides additional confirmation that greater use among the population using ICTs leads to higher peak convergence rates though the timing of the peak convergence rate is later with increasing use. See Figures 17 and 18.

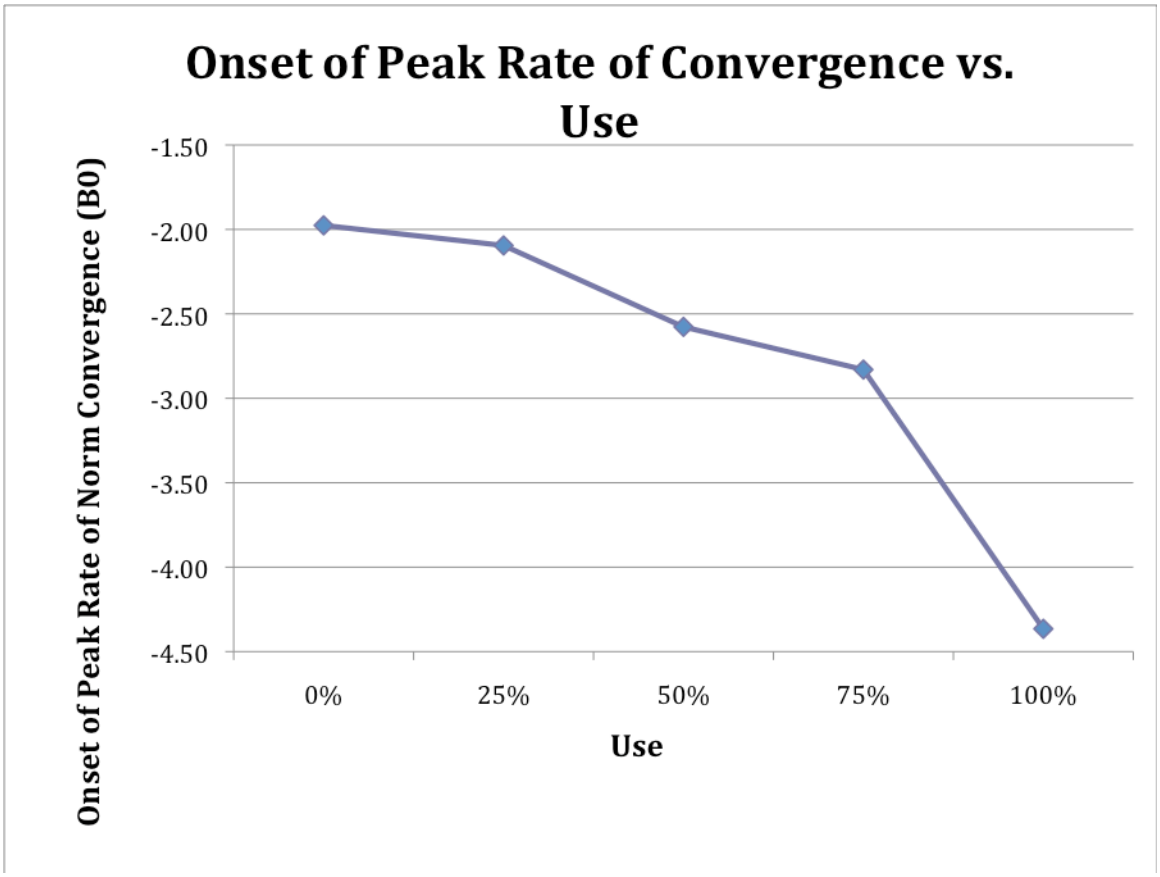


Figure 17: The peak Rate of convergence, B0 vs. Use

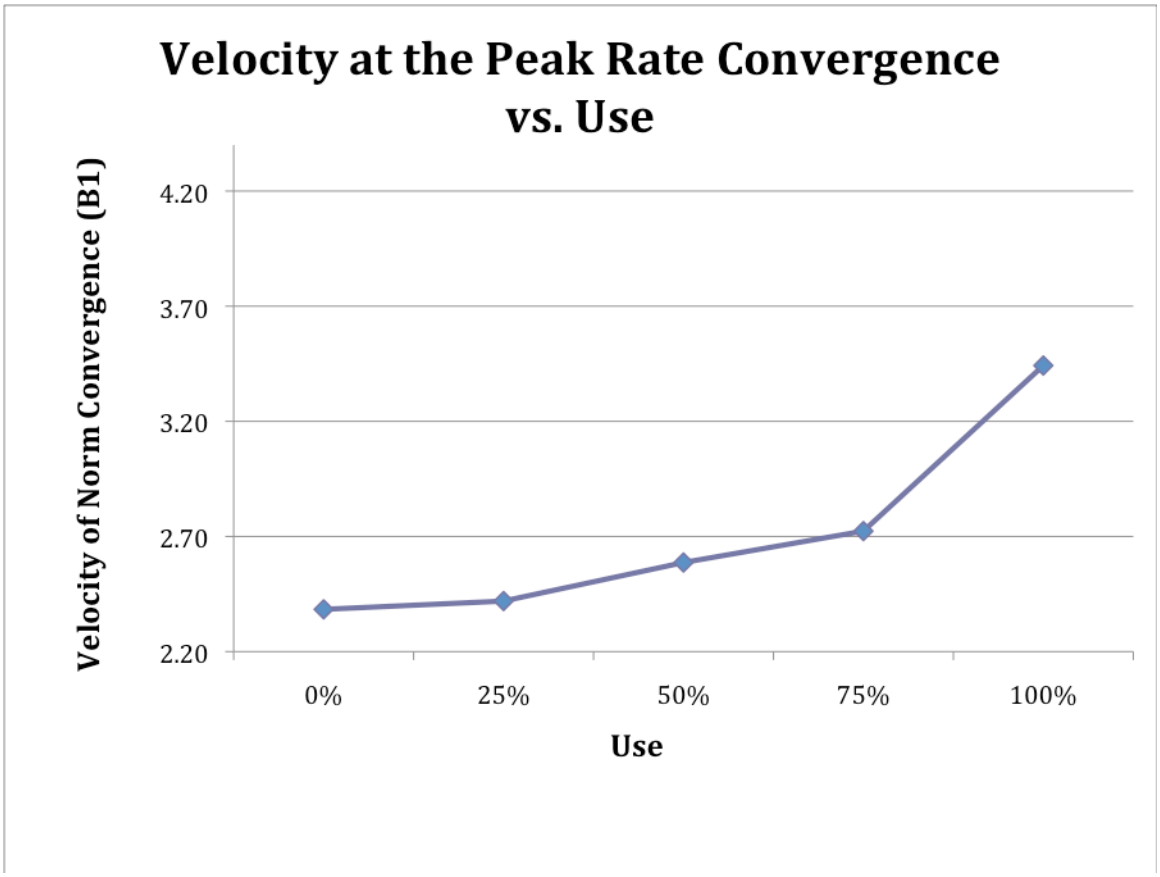


Figure 18: Velocity at the Peak, B1 vs. Use

Regarding the impact of adoption, this analysis confirms increasing adoption increases the velocity of the spread of norms particularly at the initial smaller levels of adoption. In addition, higher levels of adoption does increase the peak rate of convergence, but this peak is seen to occur later; and once the level of adoption reaches higher levels, the rates of convergence begins to decline. See Figures 19 and 20.

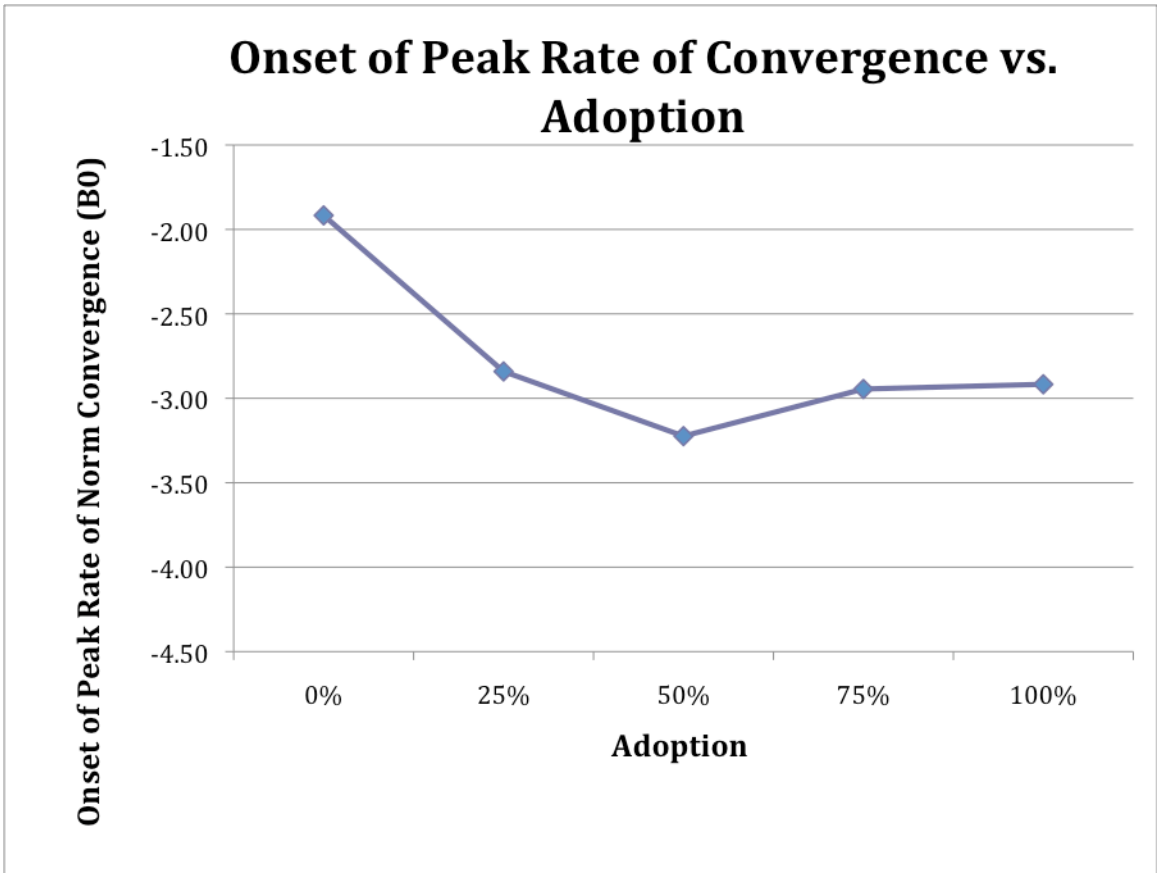


Figure 19: The Onset of the Peak Rate of convergence, B0 vs. Adoption

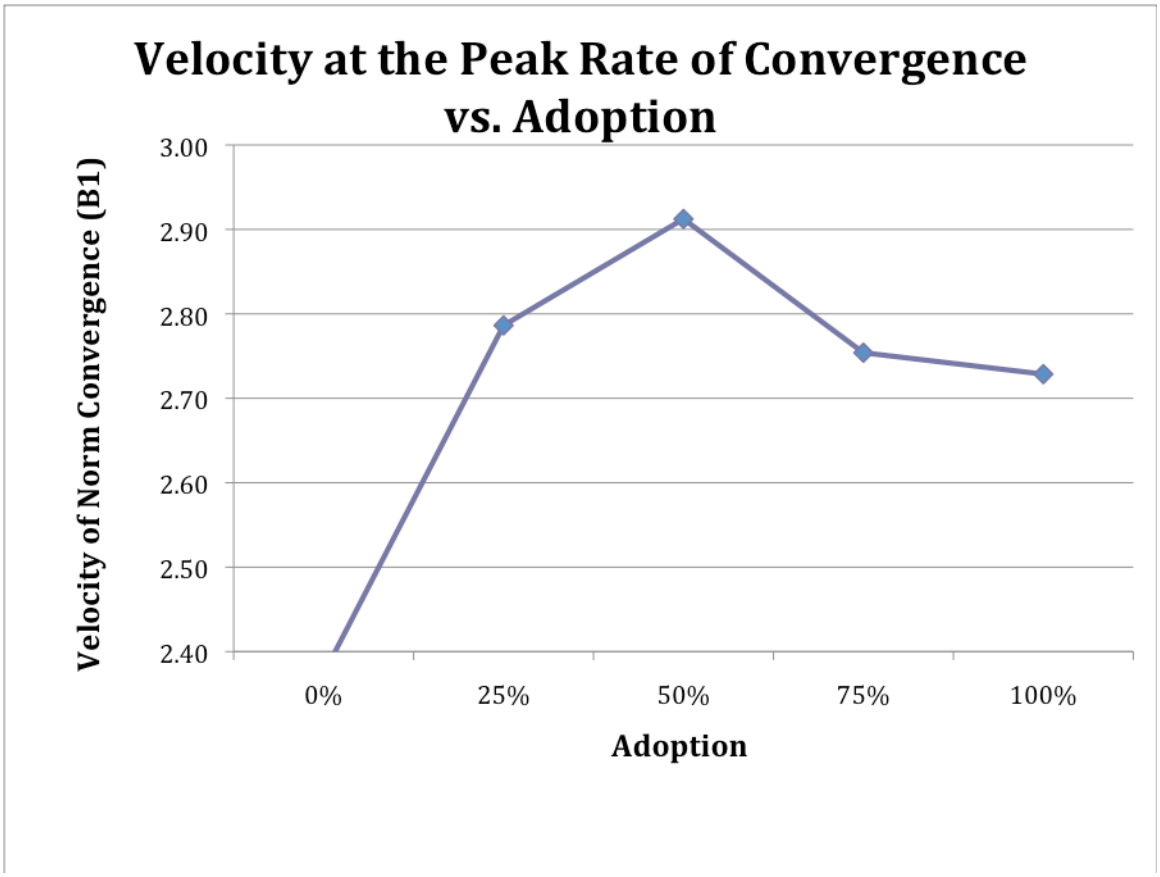


Figure 20: Velocity at Peak, B1 vs. Adoption

To provide even further examination of the change in velocity over time for varying levels of ICT use and adoption, the smoothing transformation was applied to the curves reflecting the change in the number of norms over time for each run. The smoothing transformation consisted of averaging the three measures for slope at the steepest points along the curve. The smoothing transformation was applied to ensure that any irregularities in the sigmoid curve did not skew the results for identifying the peak rate of norm convergence. See Figures 21 and 22.

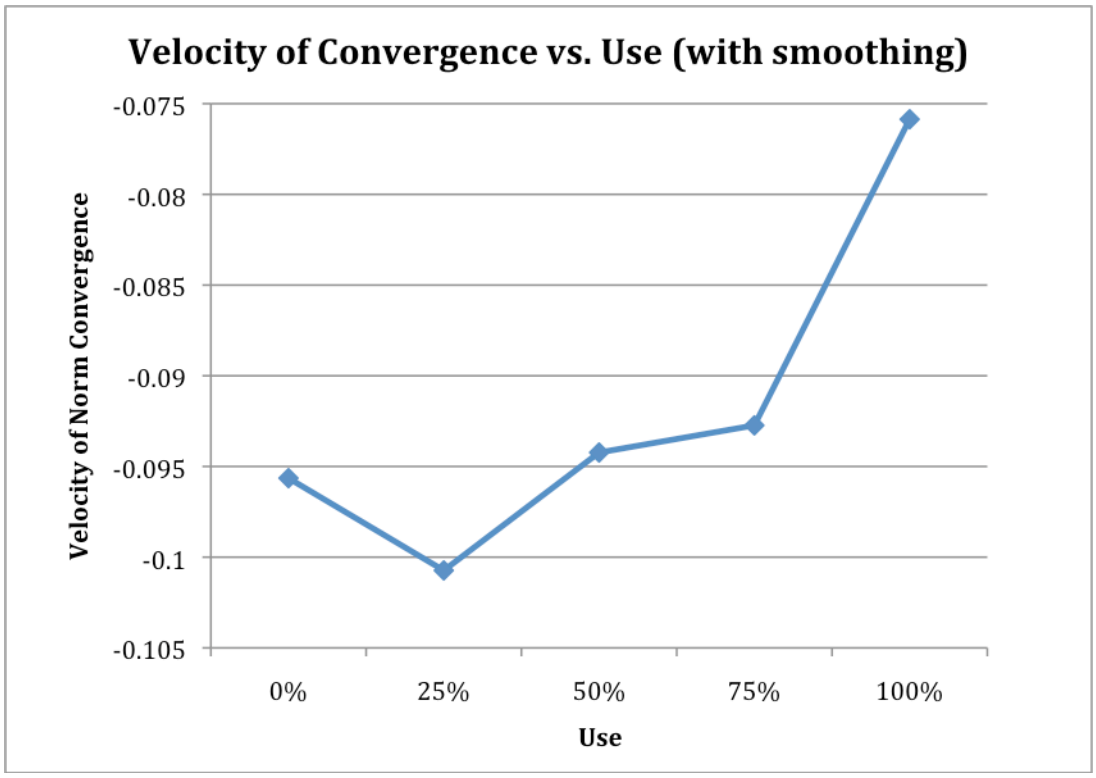


Figure 21: Velocity of Convergence versus Use with smoothing applied

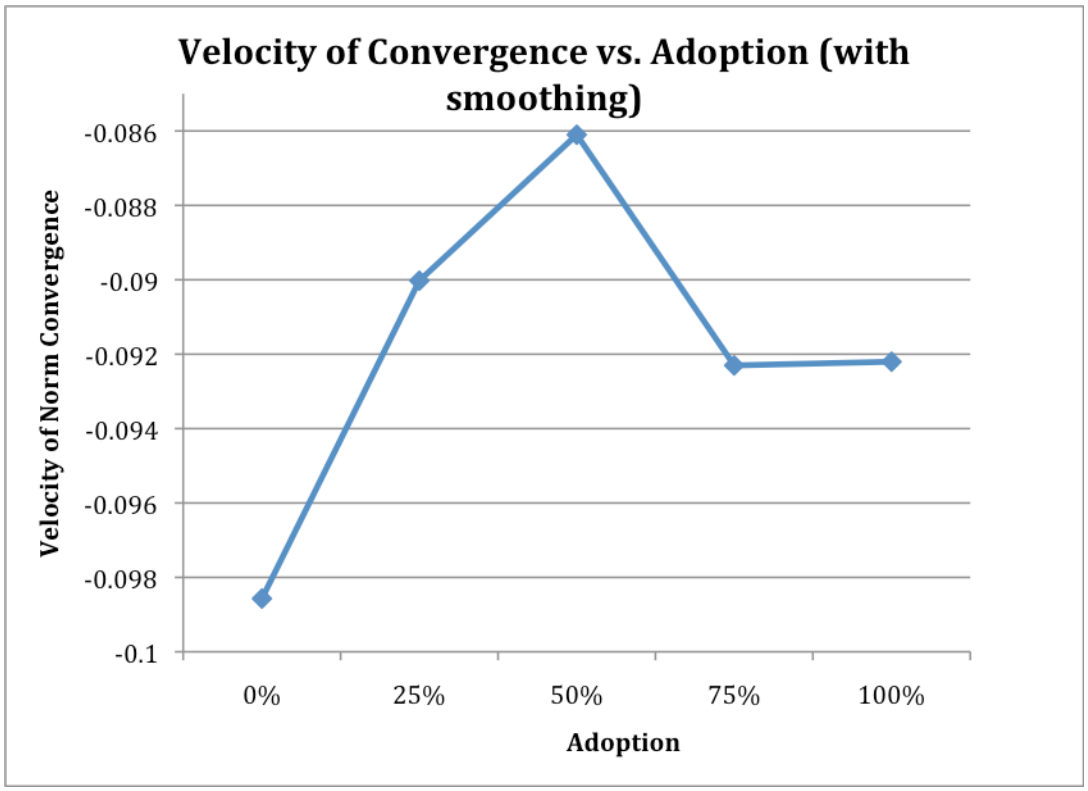


Figure 22: Velocity of Convergence vs. Adoption with smoothing applied

Analysis of variance for the mean velocity of convergence for use and adoption yielded a significance difference of means for varying levels of use and adoption. See Table 9. Thus, three approaches to estimating the velocity of convergence all yield a similar result. That is, small introductions of ICTs can have a huge impact on the velocity of the spread of communication norms.

Table 9: ANOVA Mean Velocity of Convergence for Use and Adoption (with smoothing)

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Use	Between Groups	0.018	4	0.004	9.86	0
	Within Groups	0.11	245	0		
	Total	0.128	249			
Adoption	Between Groups	0.005	4	0.001	3.718	0.006
	Within Groups	0.08	245	0		
	Total	0.085	249			

DISCUSSION

Several interesting findings come from the data in this research. Most notably, the effect of introducing ICTs to a small portion of the population produces rapid increases in velocity, size of the dominant norm and diversity in the overall population but particularly in the group without ICTs. In each case, this sudden increase is followed by a much smaller change in the dependent variable. What is particularly interesting is that the communication norms of the groups with ICTs tend to propagate and quickly dominate the larger population.

The dynamics illustrated in this simulation may be of special interests to practitioners

who are weighing different options for how and to whom to introduce technology. The "how" involves whether the technology will be phased into the larger group. As seen from the results of this simulation, introducing just a small portion of the population to the new communication technologies can have a huge impact on the larger communication norms of the population that has not been introduced to the technology. This has implications in large organizations where technologies may be piloted to a small group before introducing the technology full-scale. The results of this simulation indicate that such a strategy may have consequences beyond the group selected for the pilot. Thus, in situations where management is interested in carefully controlling or containing corporate communication practices or conventions it should be noted that a small introductions of technology can go a long way in influencing the way workers communicate with one another.

The question of to whom technology should be given should also receive careful consideration. The results of this experiment suggest that the communication norms of the group with ICTs are more likely to be propagated across the entire population. Thus, the norms of the organization as a whole will be biased towards the norms of those using ICTs. This is an important consideration for management when grappling with the question of which group within the organization should receive a new technology if a phased implementation approach is planned. Since communication norms of the group utilizing ICTs will have a larger influence, management should take heed not to select groups with unfavorable communication practices. By contrast, if there is a group within the population that provides exemplary communication norms then this group may be the

ideal group with which to begin the introduction of new communication technologies.

This simulation is has limits. There is a reciprocal relationship between technology and the social construction of communication norms. That is to say that technology is a socially constructed artifact that will in turn impact social processes. This continuous nature of the process is not reflected in this model. However, this model does provide a glimpse at the complexities that arise when looking at the process in one direction. The simulation illuminates how communication technologies shape communication norms, but the influence of communication norms on technology appropriation was beyond the scope of this project.

In addition to the role of technology, there are differing sources of influence in the formation of communication norms. This simulation provides a parsimonious model for examining influence spurred by interaction in dyadic relationships. It examines one facet of socially constructed communication norms. A potential extension to this research might be to explore the impact of factors that provide tension such as the presence of centralized communication policy. This research provides an example of how information and communication technologies can provide an impetus that has a nonlinear influence on the spread of communication norms. It provides a unique perspective for managers that may spur or inhibit the adoption and use of ICTs. The results of this research suggest that the use and adoption of ICTs create both short-term and long-term effects on the diversity and trajectory of the spread of communication norms, with the short-term effects being highly pronounced.

Chapter 3: Information and Communication Technologies: Exploring the Dimensionality of Preferences

Introduction

IS research can greatly benefit from a systematic classification that allows the comparison of technology features without being subject to the ephemeral nature of underlying technologies (Stewart 2002). From a practitioner's standpoint, organizations must determine which aspects of communication will be changed and disrupted by rearranging and replacing communications technologies (DeSanctis et al. 1994a). This chapter examines media capability classifications presented in Media Synchronicity, introduces an instrument for measuring preferences for these capabilities, and suggests a new capability that expands Media Synchronicity Theory.

To provide context for this chapter, several theories related to media traits and communication processes are discussed. These theories provide background for the formulation of an instrument to measure preferences for communication capabilities and the formation of the concept of discretion as a new media capability.

Media Theory

Early media selection theories center on a common question: Why is one medium of communication preferred over another? At the origin of this line of inquiry are series of theories that attempted to address this question by matching media trait to task. Media Richness Theory suggested that media can be compared based on its richness and that

rich media--those that allow for greater feedback, cues, language variety, and personal focus --were better suited for equivocal tasks (Daft et al. 1986). In addition, Media Richness Theory suggests that media can be ranked based on its relative richness, with face-to-face being the richest media and memos and letters being the leanest (Daft et al. 1987).

The strength of Media Richness Theory has waned in recent years as researchers have pointed out a single medium may be multi-trait and that any attempts to rank specific media are of questionable value. In addition, Media Richness Theory has not been supported empirically. Numerous studies do not show a clearly distinguishable advantage to supposedly richer media (e.g. video communications) over leaner media (e.g. text and or audio-based communications) (Dennis et al. 1998a; Kasper et al. 1988; Marshall et al. 1995). On the contrary, research has shown that leaner channels can be effective for complex communication given organization support (Markus 1994).

The significance of the "task medium fit" hypothesis has also been countered (DeSanctis et al. 1999a; Krueger et al. 1980), with some suggesting that medium influences task rather than the opposite relationship (Marshall et al. 1995). For example, Marshall (1995) found that when using the phone workers were more task oriented and the medium of communication influenced the priority given to a task. With the weight of task as factor in media selection in question, researchers have begun exploring other potential factors.

In addition, it has been suggested that individuals select sequential and concurrent combinations of media to achieve communication goals such as message acknowledgement, enhancement of mutual understanding, and participation in multiple communication interactions (Bélanger et al. 2006). The shift from emphasis on single media selection to multiple media selection is thought to be influenced by the rise of more distributed work environments (Woerner et al. 2004). Scholars have began to emphasize that media selection is based on more than just the physical aspects of the medium (Nardi et al. 2002) and

Media Capabilities

There have been a number of efforts to examine the communication capabilities introduced by information and communication technologies. Arguably one of the most influential contributions to current scholarship on media selection is Media Synchronicity Theory (Dennis et al. 1999). Media synchronicity theory suggests that communication can be encapsulated in two key processes: conveyance and convergence. In addition, Dennis suggests that media are best analyzed based on communication capabilities, and Media Synchronicity Theory provides a concise summary of the theoretical foundation for each. These capabilities (feedback, symbol variety, parallelism, rehearsability, and reprocessability) can be matched with the communication processes of conveyance or convergence to optimize communication depending on the level of equivocality associated with the task being performed (Dennis et al. 1999).

Media Synchronicity Theory provides a much needed foundation for categorizing media beyond physical properties. Other frameworks have been suggested, but Media Synchronicity provides a parsimonious model. This framework for categorizing capabilities will be employed and expanded in the current research. In addition to the capabilities proposed by Dennis, this research will explore an additional capability afforded by communications media: discretion.

Privacy and Disclosure

In part, Media Synchronicity Theory is based on the Shannon Weaver Theory that outlines the fundamental basis for communication systems. Dennis's communication capabilities--velocity, parallelism, symbol sets, rehearsability, reprocessability--are drawn from Shannon and Weaver's concepts of channel capacity, frequencies, symbol types, encoding, and decoding respectively (Dennis 2008) (Shannon et al. 1949). In a follow-up to his seminal Communication Theory, Shannon introduced his Communication Theory of Secrecy Systems (Shannon 1949), which provided a conceptual framework for "secrecy systems" to conceal messages and ensure privacy. Although focused on providing a theoretical foundation for cryptography, this early work highlighted the importance of scholarship related to information privacy and communication security. Decades later, research on privacy and information security spans multiple disciplines including computer science, economics, information systems, and public policy, among others.

Concern for controlling the flow of information between parties with potentially different priorities, values, or objectives is at the center of research on information security and privacy. Communication between individuals is subject to intentional manipulation for a number of reasons. For example, a message may not be received correctly if there is interruption between sender and receiver. Congested communication spaces create the need for message communication among a subset of individuals to avoid message interruption. Likewise, when communication is open and visible to a large number of participants, there is risk that a message may be intercepted or received by an unintended party instead of, or in addition to, the intended party. Finally, in the absence of targeted communication between a sender and only the intended recipient messages may be subject to modification before being received by the intended recipient (Stallings 1998).

Given the numerous ways in which information can be misdirected or misused, research indicates that individuals by and large have a high degree of concern for privacy (Mason 1985; Smith et al. 1996) However, much of IS research related to privacy has focused on the securing of data containing demographic, identity, or financial information collected about an individual. The complexities that arise when a user willingly and openly displays personal information in the form of a personal profile or related content found in blogs and social networking web sites remains underexplored area of research (Weiss 2004). In these emerging social media contexts, hiding personal information is contradictory to the spirit of the technology. Thus, there is an implicit contradiction between findings from research on the user concern for privacy and the trend towards greater disclosure seen in the rise of social media. There is a need to explore with greater

detail individual preferences for a medium's capacity to handle private communication. This research explores the introduction of discretion, a new communications capability that would help augment those originally proposed by Media Synchronicity Theory. Discretion is defined as the user's perceived ability of the medium to engage in private or hidden communication.

Discretion in Communication

While modern work environments focus on team based work and more open decision-making, workers today, like workers in the past, still have the need to engage in discussions that are of a more private nature. Discussions deemed unsuitable for the entire team are taken "offline," aside or away from the hearing or even awareness of other team members. Emerging communications technologies have created new spaces and pathways for hidden or concealed conversations. The motivations behind these hidden conversations are numerous. For example, managers may be reluctant to openly communicate undesirable information or unpleasant news (Lave et al. 1991; Tesser et al. 1975). Instead, managers may rely on back channels or secret conversations to distance themselves from a message with content that may be perceived as negative and delegate the dissemination of a more palatable version of this information to someone else (Folger et al. 2001). Thus, managers sometimes use hidden or private communication to separate themselves from seemingly unfavorable communication for image purposes.

In addition to unfavorable information, managers also employ secret communication to conceal confidential information. Research suggests that communicators associate the

confidentiality of the message with the attributes of the medium. For example, if a manager has private information that may influence the decision making process during a meeting, the manager may opt to pull key decision-makers aside and present this information in confidence. For example, using electronic media the sender may opt to send an SMS message during the meeting to discretely get the information across.

Users may also seek private ways of communicating when the content of the message is of an emotional or deeply personal level. Researchers have noted that the development of relationships is related to increased self-disclosure (Derlega et al. 1993). Being able to express one's innermost thoughts creates bonds, and individuals have a need for other to see one's true self (Bargh et al. 2002). Obviously, not every communication medium is routinely utilized for the expression of emotional content. Outside of the influence of communication norms, users actively choose in which medium to communicate deeply personal messages, and some media are more favored than others. For example, text messaging is thought to aid in the development of close knit adolescent relationships (Hu et al. 2004; Reid et al. 2004). This suggests that some communications media have a greater capability for supporting discretion.

Related to the need to convey emotional information, users also select media based on the ability to grab the attention and connect with one another on an individual level. For example, it has been suggested that mobile phones create a more personal, micro-social connection (NyÌri 2006). Cell phones provide the ability to develop instant access to a

network of contacts based on the individual. Users can quickly engage in one on one calls that allow communications that can be conducted without a trace.

In summary, information and communication technologies that provide a high degree of discretion are ones that allow hidden communication in which the sender can actively select a sub set as message recipients in a manner that is hidden from the larger community. A high degree of discretion allows for conversations that can be conducted in parallel to other discussions and remain undetected. Text messaging (via SMS, Blackberry, etc.) is an example of a technology that provides a high degree of discretion and would also fall under Shannon's concealment and privacy categories

Hypotheses

The discretion capability is hypothesized to be positively related to the argumentative communication trait. It expected that individuals who gain satisfaction from directly challenging the views and positions of others would prefer communications technologies that allow for private conversations. The rationale being that technologies with his capability allow the argumentative individual the opportunity to engage others in arguments without interruption and without concern over how open argumentation in front others may be perceived.

H1. The discretion communication capability will be positively associated with the argumentative communication trait.

In addition, discretion is expected to by positively related to communication apprehension. It is hypothesized that individuals who are timid or hesitant to communicate may prefer communication technologies that allow for hidden communication.

H2. The discretion communication capability will be positively associated with the apprehensive communication trait.

Research Method

This research introduces an instrument to measure user preferences for communications capabilities and seeks to develop measures for a new media capability: discretion. See Table 9 for summary. To explore factors associated with media capabilities, items were developed with guidance from theory on privacy concepts. The items measure individual preferences for communication technology capabilities (feedback/velocity, symbol variety, rehearsability, reprocessability, parallelism, and discretion), but were intended to be communication channel and technology independent. Each item is measured on a five point Likert scale with instructions for participants to "indicate how well each item describes you." Participants could respond within a range from a "clearly does not describe me" to "clearly describes me," with the former being indicated by a value of one and the latter indicated by a value of five.

Table 10: Existing and Proposed Media Capabilities

Capability	Definition	Key Concepts
Velocity	The ability to communicate and receive evaluative or corrective information on a previously transmitted message	Frequency (Shannon et al. 1949)
Symbol variety	The ability to provide the numerous cues and language variety	Symbol sets (Shannon et al. 1949)
Parallelism	The ability to engage in more than one separate conversation	Channel capacity (Shannon et al. 1949)
Rehearsability	The ability to compose and edit a message to ensure exact meaning prior to communication	Encoding (Shannon et al. 1949)
Reprocessability	The ability to repeatedly process, review, or recall a message	Decoding (Shannon et al. 1949)
Discretion	The ability to engage in private or hidden communication	Concealment and privacy (Shannon 1949); Interruption and interception (Stallings 1998)

Once a preliminary set of items was developed, open coding was performed separately by a group of individuals to assess the logical grouping of concepts reflected in the proposed questions. For this activity, individuals where given index cards each containing a single survey question. The participants were asked to sort the cards into what they perceived as related groups. The results of coding suggested that the items grouped into six underlying factors as anticipated.

With coding complete, the next step was to conduct a pilot of the instrument. A participant pool of 100 undergraduates was used to pilot the survey. In the end, 85 valid responses were received. Analysis of the data upheld some of the initial hypothesis; however, adjustments to the instrument were deemed necessary. The survey was determined to be too lengthy (104 items) as the average completion time was near 15 minutes. A second version of the instrument was developed. This version of the instrument contained fewer items (64) and took an average of about 6 minutes to complete. The participant pool consisted of approximately 80 Evening MBA students. A total of 44 valid responses were received.

The final instrument included six items to measure each of the factors along with questions designed to capture demographic and computer self-efficacy data. The instrument is included in Appendix A.

A web-based survey was conducted using participants from a wide range of industries and occupations. A total of 692 knowledge workers participated in the survey. Statistics on the sample population are given in Table 11.

Table 11: Select Sample Statistics

	Percent of Total Sample
Age	
18-24	10.9
25-30	9.8
30-39	30.4
40-49	29.1
50-59	15.6
60+	4.2
Computer Experience	
Advanced	62
Intermediate	36
Beginner	1.7
No Experience	0.3
Industry	
High Tech/Info Systems	28.5
Entertainment/Media	20.5
Manufacturing	5.3
Retail	5.3
Healthcare	5.8
Education	2.5
Finance	2.8
Real Estate	0.3
Other	29.1

Table 12 shows the mean preference ranking for the six media capabilities. Results of the response statistics indicate that on average participants rated a preference for reprocessability highest (with an average 3.7 out of 5) and rehearsability lowest (with an average of 3.1 out of 5).

Table 12: Response Statistics

	Mean	Std.
Velocity	3.43	0.86
Symbol Variety	3.52	0.74
Parallelism	3.29	0.92
Rehearsability	3.11	0.89
Reprocessability	3.72	0.77
Discretion	3.36	0.93

Results

Originally 6 items were included to measure preferences for technology capabilities. (See Appendix B for the full set of factors and items used to measure them). However, initial analysis revealed that the reliability of the measures for velocity reprocessability and discretion could be improved if select items were removed. For the velocity measure, the first three items were omitted; for reprocessability, the first and second items were omitted. Finally, for discretion the second and third items were omitted. Table 13 below provides the Cronbach Alphas obtained for using both the original and adjusted set of items.

Table 13: Reliability Statistics for Factors

Factor	Alpha	N of
Velocity	0.699	6
Velocity (adjusted)	0.728	3
Symbol Variety	0.84	6
Parallelism	0.893	6
Rehearsability	0.859	6
Reprocessability	0.696	6
Reprocessability (adjusted)	0.869	4
Discretion	0.819	6
Discretion (adjusted)	0.852	4

Next, to explore the underlying structure of the communication capability factors included in this research, factor analysis was performed. However, prior to conducting factor analysis, Bartlett's Test for Sphericity and the Kaiser-Meyer-Olkin KMP measure of sampling adequacy were performed. Bartlett's test yielded a significance of .000 and KMO yielded a .869, well above the threshold of .6 suggested for a good factor analysis (Tabachnick & Fidelll 2007).

Factor analysis was performed using principle component analysis (PCA) with Oblimin rotation and Kaiser Normalization. This analysis indicated six underlying factors being measured by the communication capabilities items, as expected. Only factors with eigenvalues greater than 1 are considered significant. The first factor accounted for 22% of the variance. See Table 14.

In examining the relationship between discretion and the communication traits described in Chapter 1, the data indicate that there is a positive relationship between the argumentative communication trait and the preference for the discretion capability and hypothesis 1 is supported. However, there is no support for the relationship between discretion and communication apprehension so hypothesis 2 is not supported. All results are given in Table 15.

Table 14: Factor Loadings and Structure Matrix for Principle Component Analysis

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Velocity4	0.521	0.001	0.046	-0.48	-0.217	0.724
Velocity5	0.305	-0.233	0.012	-0.276	0.13	0.783
Velocity6	0.424	-0.1	0.036	-0.364	0.002	0.782
Symbol Variety1	0.1	0.159	0.13	-0.699	-0.063	0.097
Symbol Variety2	0.165	0.128	0.05	-0.773	-0.062	0.271
Symbol Variety3	0.291	-0.028	0.042	-0.798	-0.142	0.296
Symbol Variety4	0.385	0.017	0.001	-0.842	-0.161	0.392
Symbol Variety5	0.357	0.127	-0.053	-0.745	-0.177	0.418
Symbol Variety6	0.35	-0.093	0.127	-0.614	-0.237	0.338
Parallelism1	0.772	0.013	0.164	-0.282	0.111	0.327
Parallelism2	0.739	-0.078	-0.04	-0.171	0.256	0.212
Parallelism3	0.796	-0.083	0.01	-0.318	-0.174	0.47
Parallelism4	0.882	-0.091	0.029	-0.333	-0.15	0.346
Parallelism5	0.814	-0.066	0.045	-0.224	-0.241	0.301
Parallelism6	0.858	-0.134	0.034	-0.323	-0.194	0.45
Rehearsability1	-0.148	0.824	0.19	-0.003	-0.179	-0.183
Rehearsability2	0.091	0.184	0.115	-0.202	-0.74	-0.015
Rehearsability3	0.008	0.815	0.178	-0.171	-0.223	-0.09
Rehearsability4	-0.065	0.826	0.151	-0.041	-0.135	-0.096
Rehearsability5	-0.093	0.852	0.151	-0.084	-0.174	-0.062
Rehearsability6	-0.132	0.823	0.196	-0.071	-0.279	-0.142
Reprocessability3	0.015	0.604	0.243	-0.055	-0.448	0.138
Reprocessability4	-0.039	0.406	0.235	-0.114	-0.613	0.188
Reprocessability5	0.054	0.655	0.208	-0.053	-0.631	0.069
Reprocessability6	0.056	0.307	0.312	-0.138	-0.724	-0.022
Discretion1	0.017	0.22	0.829	-0.034	-0.115	-0.061
Discretion4	0.016	0.19	0.829	-0.063	-0.041	-0.034
Discretion5	0.09	0.08	0.831	-0.029	-0.27	0.174
Discretion6	0.047	0.19	0.859	-0.118	-0.233	0.127
Eigenvalues	6.472	5.419	2.57	2.113	1.478	1.021
% of Variance	22.3	18.7	8.9	7.3	5.1	3.5

Table 15: Pearson Correlations

	Communication Traits				
	Argumentativeness	Apprehensive (Group Communication)	Animated	Wit	Articulation
Discretion	**.119***	**0.038**	.138**	0.09	-0.069

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-taile d).

Discussion

The development of scales to measure preferences for communication media capabilities provides an important step forward in producing robust instruments for IS research. The scales used in this research are applicable to the design of a wide application of communication technologies. As the field of telecommunications expands to include multiple pathways and individualized preferences for communication, it is worthwhile to consider the relationship between our communication preferences and technology design. In online marketing environments, the effectiveness of communicating with customers hinges on the ability to understand differences in how to reach customers. Customers would presumably have preferences for how they wish to engage in computer-mediated communication. The instrument developed in this research could be the foundation for structuring interactive elements.

The introduction of discretion as a media capability augments the existing set of capabilities offered by Media Synchronicity Theory. The concept of discretion as a technology affordance helps to illuminate the contradictory concerns over privacy and the need to disclose. It provides a conceptual beginning for research that explores media choice using technology-independent constructs that be used across multiple applications of communications technology and interactive design. Examining discretion in light of the communication traits described in Chapter 1 indicates that the preference for discrete communication modes is correlated with certain communicator traits. Future research might explore how this new factor is related to additional individual factors (personality, culture, etc.) outside the scope of this research.

Though the scales developed in this research avoid explicit references to technology or specific communication channels, it should be noted that participants might respond to questions with a personal bias towards a particular mode of communication. For example, an individual who only uses email may be inclined to express preferences based on experience communicating primarily in this mode. As communications technologies become more widely adopted and individuals develop broader mental concepts of the act of communicating, this bias may diminish.

Conclusions

Emerging information and communication technologies (ICTs) offer unparalleled opportunities for individuals to interact and collaborate, and knowledge workers have a myriad of tools for connecting and communicating. Given the wide range of options, individuals can now develop personalized bundles of communication technologies to match their unique communication styles in addition to meeting task related needs. Given the accelerated pace at which new ICTs are introduced, much of previous research on media selection is unable to address the complexities that arise as new modes of communicating are created and combined. In addition, past empirical studies lack the robustness needed to extend the findings to newer technologies. This not only presents a problem for theory development, but it also undermines the ability to link theory to practice as technology continuously evolves. This dissertation addressed the widening gap in the media research that has arisen due to the myriad of interaction modes offered by new information and communication technologies.

The first and third chapters of this dissertation examine the role of individual traits as an appropriation factor in the selection of communication technologies. While there have been many studies to explore the role of task characteristics and context, this research is among few studies to look at factors intrinsic to the individual. In today's workplace, knowledge workers have an array of communications technologies to choose from, and this research demonstrates that individuals with select communication traits show a greater preference for certain communication capabilities over others.

This study is among the first to explore individual traits within the lens of Media Synchronicity Theory and thereby extends the current understanding of how the communication style of the individual mediates the relationship between technology capabilities and actual use. The introduction of discretion as a media capability augments the existing set of capabilities offered by Media Synchronicity Theory. From a practitioner standpoint, this research offers an understanding of ways in which knowledge workers can more effectively manage numerous communication options and avoid information overload. Also, technology designers can better optimize the mix of technologies made available to knowledge workers.

Another significant contribution of this work is the introduction of scales to measure the media capabilities presented by Media Synchronicity Theory. IS research can greatly benefit from robust instruments to investigate the IT artifact across various contexts and implementations. The scales used in this research are applicable to the design of a wide application of communication technologies. The concept of discretion as a technology affordance helps to illuminate the contradictory concerns over privacy and the need to disclose. It provides a conceptual beginning for research that explores media choice using technology-independent constructs that be used across multiple applications of communications technology and interactive design

As the field of telecommunications expands to include multiple pathways and individualized preferences for communication, it is worthwhile to consider the relationship between our communication preferences and technology design. In

electronic commerce customers may presumably have preferences for how they wish to engage in computer-mediated communication. The instrument developed in this research can be the foundation for structuring interactive elements.

The second chapter explored the relationship between the use of ICTs and communication norms. It examines the dynamics of how the use of communication technologies influences communication norms. With the use of an agent based computer model, the diffusion of communication norms was investigated. A number of interesting findings arise from this model. The effect of introducing ICTs to a small portion of the population produces rapid increases in rate of change in the communication norms for the entire population. Moreover, the communication norms of the groups with ICTs tend to propagate and quickly dominate the larger population. These findings may be of interest to practitioners who are weighing different options for introducing technology. For example, will the new communications technology be deployed to the entire workforce or will a phased approach be selected?

As seen from the results of this simulation, introducing just a small portion of the population to the new communication technologies can have a huge impact on the larger communication norms of the population that has not been introduced to the technology. This has implications in large organizations where technologies may be piloted to a small group before introducing the technology full-scale. The results of this simulation indicate that such a strategy may have consequences beyond the group selected for the pilot. Thus, in situations where management is interested in carefully controlling or containing

corporate communication practices or conventions it should be noted that a small introductions of technology can go a long way in influencing the way workers communicate with one another. An example of this can be seen in the way email communication and essentially seamless connectivity between work and home have created new expectations for reachability and responsiveness beyond traditional work hours in many organizations.

The results of computer-based model used in this experiment also suggest that the communication norms of the individuals first receiving ICTs are more likely to be propagated across the entire population. Thus, the norms of the organization as a whole will be biased towards the norms of those using ICTs. Since communication norms of the group utilizing ICTs will have a larger influence, management should take heed not to select groups with unfavorable communication practices and instead consider introducing new communication technologies to the portion of the workforce with more exemplary communication norms.

Taken together the works presented in this dissertation provides a unique view into how individuals select communications technologies based on communication style and how these technologies in term shape the style of the individual. This work reaffirms the interplay suggested in Adaptive Structuration Theory and extends our understanding of Media Selection Theory. As a whole this research suggests that the ways in which we select information and communication technologies is rooted more deeply than nature of

the task or context provided by circumstances and is influenced by individual factors both internally and externally created.

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Appendix A: Survey Instrument

Comm Traits and Tech Preferences 6

Page 1 of 6

Consent for Survey

1. Introduction/Purpose: You are being invited to voluntarily participate in this research study. We are conducting this research in order to learn more about how individuals communicate. Procedures: This study involves an exercise in which you will answer a series of questions via this web site. Participation in this survey takes approximately 5 minutes. Taking part in this study may not benefit you personally, but we hope to learn things that will help us to understand communication styles. Confidentiality: We will keep all facts about you private. We will not collect any medical or other private information beyond your perceptions of the exercise and its outcome. We will treat this information as confidential and it will not appear when we present the study or when the results are published.*

   ○ I certify that I am at least 18 years old and I am voluntarily participating in this study.*

Next Cancel

Comm Traits and Tech Preferences 6

2. In order to view your summarized results on this survey, please provide a password of your choice (remember to write this down, you'll be asked to enter it in the Personal Communications Profile spreadsheet).*

Back Next Cancel

Comm Traits and Tech Preferences 6

3. Please indicate how well each item describes you*
(1=Clearly DOES NOT describe me ... 5=Clearly describes me

	1	2	3	4	5
People think that I am witty.	O	O	O	O	O
I often re-examine prior communication	O	O	O	O	O
I am very expressive nonverbally in social situations.	O	O	O	O	O
I often engage in several conversations simultaneously	O	O	O	O	O
I am energetic and enthusiastic when I argue.	O	O	O	O	O
I use a great deal of variety in the way I get messages across	O	O	O	O	O
I often engage in confidential communication with select individuals separate from the larger group	O	O	O	O	O
I often review what has been communicated previously before responding	O	O	O	O	O
I often seek confidential communication with select individuals	O	O	O	O	O
When speaking, I have problems with grammar.	O	O	O	O	O
I communicate with others in a way to make it easy for them to recall what I've communicated at a later time	O	O	O	O	O
When I am communicating with others I like make sure that they get my response right away	O	O	O	O	O
When someone makes a negative comment about me, I respond with a witty comeback.	O	O	O	O	O
Typically when I communicate, I have already given plenty of thought to what I am about to communicate	O	O	O	O	O
I actively use a lot of facial expressions when I communicate.	O	O	O	O	O
When communicating within a group, I frequently find it necessary to have separate communications with a subset of group members (apart from the group as whole).	O	O	O	O	O
I enjoy using creative ways to illustrate my message when communicating	O	O	O	O	O
I consider an argument an exciting intellectual challenge.	O	O	O	O	O
I have the ability to do well in an argument.	O	O	O	O	O
Generally, I am comfortable while participating in a group discussion.	O	O	O	O	O
I communicate in way such that others can remember what I have communicated	O	O	O	O	O
When I am anxious, I often make jokes.	O	O	O	O	O

Comm Traits and Tech Preferences 6

4. Please indicate how well each item describes you*
(1=Clearly DOES NOT describe me ... 5=Clearly describes me

	1	2	3	4	5
I prefer to only conduct one conversation at a time	O	O	O	O	O
Engaging in a group discussion with new people makes me tense and nervous.	O	O	O	O	O
It is important to me to be able to express the same message in different ways when I communicate.	O	O	O	O	O
I am likely to use a variety of tactics to get a message across.	O	O	O	O	O
I find innovative ways to communicate	O	O	O	O	O
My eyes reflect exactly what I'm feeling when I communicate.	O	O	O	O	O
Arguing over controversial issues improves my intelligence.	O	O	O	O	O
I express myself without hesitation	O	O	O	O	O
I dislike participating in group discussions.	O	O	O	O	O
I feel refreshed and satisfied after an argument on a controversial issue.	O	O	O	O	O
I typically revise a message many times before I communicate.	O	O	O	O	O
I like to get involved in group discussions.	O	O	O	O	O
I often communicate with select individuals in a manner that is kept private from others.	O	O	O	O	O
I enjoy a good argument over a controversial issue.	O	O	O	O	O
When I embarrass myself, I often make a joke about it.	O	O	O	O	O
I tend to edit a message repeatedly before communicating	O	O	O	O	O
I am very creative when I communicate	O	O	O	O	O
I often go back and review or recall what I have communicated.	O	O	O	O	O
I am effective at communicating with several people at once.	O	O	O	O	O
It often takes me a while to respond to others once they've communicated with me	O	O	O	O	O
I can communicate with several people at once	O	O	O	O	O
I can communicate regarding several different topics at once	O	O	O	O	O

Comm Traits and Tech Preferences 6

5. Please indicate how well each item describes you*
(1=Clearly DOES NOT describe me ... 5=Clearly describes me

	1	2	3	4	5
I do not like to miss the opportunity to argue a controversial issue.	O	O	O	O	O
I enjoy defending my point of view on an issue.	O	O	O	O	O
I have a pleasant, good feeling when I win a point in an argument.	O	O	O	O	O
Confidentiality is highly important when I communicate with others	O	O	O	O	O
I can effectively maintain several conversations at once	O	O	O	O	O
I am very interactive when communicating with others	O	O	O	O	O
I often revisit previous communication to get a better understanding	O	O	O	O	O
I tend to rehearse a message several times before communicating	O	O	O	O	O
I am tense and nervous while participating in group discussions.	O	O	O	O	O
I sometimes use one word when I mean to use another.	O	O	O	O	O
I feel excitement when I expect that a conversation I am in is leading to an argument.	O	O	O	O	O
I often engage in side communication with select individuals away from the larger group	O	O	O	O	O
I have difficulty pronouncing some words.	O	O	O	O	O
By the time I've communicated, I changed my message several times to ensure that it is right	O	O	O	O	O
I tend to rehearse what I am about to communicate before saying, writing or sending my message	O	O	O	O	O
I am calm and relaxed while participating in group discussions.	O	O	O	O	O
When I am communicating with others its important for me to respond as quickly as possible.	O	O	O	O	O
At times, I don't use appropriate verb tense.	O	O	O	O	O
I am quick to contribute to discussions	O	O	O	O	O
I often make jokes in tense situations.	O	O	O	O	O
I sometimes use words incorrectly.	O	O	O	O	O
I tend to constantly gesture when I communicate.	O	O	O	O	O

Comm Traits and Tech Preferences 6

6. In which industry do you work?*

   -- Please Select --

7. What is your current job function*

   -- Please Select --

8. How frequently do you communicate via email?*

   -- Please Select --

9. How frequently do you communicate via videoconferencing?*

   -- Please Select --

10. How frequently do you communicate via text messaging (e.g. Blackberry, cellphone, SMS, etc.)?*

    -- Please Select --

11. How frequently do you communicate via instant messaging (e.g. AOL Instant Messenger, Yahoo! Messenger, Microsoft Messenger, etc.)?*

    -- Please Select --

12. How frequently do you communicate via voice conferencing (e.g. conference calls)?*

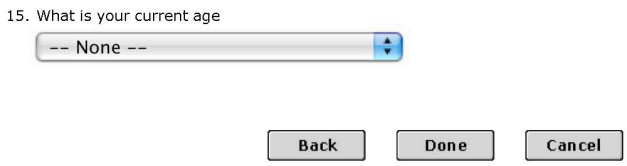
    -- Please Select --

13. How frequently do you communicate via face to face meetings?*

    -- Please Select --

14. How would you describe your level of computer expertise?*

    -- Please Select --


15. What is your current age
-- None --
Back
Done
Cancel

Comm Traits and Tech Preferences 6

Survey Completed

Thank you for taking the survey! To receive your score on select communication traits, you will need to download and open a spreadsheet used to calculate your score. Once you've opened the spreadsheet, enter the password that you created for this survey.

Download the spreadsheet at:

http://www.fc.bus.emory.edu/~Joycelyn_Streator/ViewIndividualScore6.xls?FCItemID=S0C634FFB

Note: This spreadsheet contains macros that are used to calculate your score.

If you have any comments regarding this survey please send a message to joycelyn_streator@bus.emory.edu

Close

Appendix B: Factors and Items

Factor	Item
Velocity	When I am communicating with others I like make sure that they get my response right away
Velocity*	It often takes me a while to respond to others once they've communicated with me
Velocity	When I am communicating with others its important for me to respond as quickly as possible.
Velocity	I am very interactive when communicating with others
Velocity	I express myself without hesitation
Velocity	I am quick to contribute to discussions
Symbol Variety	It is important to me to be able to express the same message in different ways when I communicate.
Symbol Variety	I enjoy using creative ways to illustrate my message when communicating
Symbol Variety	I am likely to use a variety of tactics to get a message across.
Symbol Variety	I find innovative ways to communicate
Symbol Variety	I am very creative when I communicate
Symbol Variety	I use a great deal of variety in the way I get messages across
Parallelism	I often engage in several conversations simultaneously
Parallelism*	I prefer to only conduct one conversation at a time
Parallelism	I am effective at communicating with several people at once.
Parallelism	I can effectively maintain several conversations at once
Parallelism	I can communicate regarding several different topics at once
Parallelism	I can communicate with several people at once
Rehearsability	I tend to “rehearse” what I am about to communicate before saying, writing or sending my message
Rehearsability	Typically when I communicate, I have already given plenty of thought to what I am about to communicate
Rehearsability	I typically revise a message many times before I communicate.
Rehearsability	By the time I've communicated, I changed my message several times to ensure that it is right
Rehearsability	I tend to edit a message repeatedly before communicating
Rehearsability	I tend to rehearse a message several times before communicating
Reprocessability	I communicate in way such that others can remember what I have communicated
Reprocessability	I communicate with others in a way to make it easy for them to recall what I've communicated at a later time
Reprocessability	I often go back and review or recall what I have communicated.

Reprocessability	I often re-examine prior communication
Reprocessability	I often revisit previous communication to get a better understanding
Reprocessability	I often review what has been communicated previously before responding
Discretion	I often communicate with select individuals in a manner that is kept private from others.
Discretion	When communicating within a group, I frequently find it necessary to have separate communications with a subset of group members (apart from the group as whole).
Discretion	Confidentiality is highly important when I communicate with others
Discretion	I often engage in side communication with select individuals away from the larger group
Discretion	I often engage in confidential communication with select individuals separate from the larger group
Discretion	I often seek confidential communication with select individuals
Argumentativeness	Arguing over controversial issues improves my intelligence.
Argumentativeness	I am energetic and enthusiastic when I argue.
Argumentativeness	I have a pleasant, good feeling when I win a point in an argument.
Argumentativeness	I enjoy a good argument over a controversial issue.
Argumentativeness	I enjoy defending my point of view on an issue.
Argumentativeness	I do not like to miss the opportunity to argue a controversial issue.
Argumentativeness	I consider an argument an exciting intellectual challenge.
Argumentativeness	I feel refreshed and satisfied after an argument on a controversial issue.
Argumentativeness	I have the ability to do well in an argument.
Argumentativeness	I feel excitement when I expect that a conversation I am in is leading to an argument.
Group Communication Apprehension	I dislike participating in group discussions.
Group Communication Apprehension*	Generally, I am comfortable while participating in a group discussion.
Group Communication Apprehension	I am tense and nervous while participating in group discussions.
Group	I like to get involved in group discussions.

Communication Apprehension*	
Group Communication Apprehension	Engaging in a group discussion with new people makes me tense and nervous.
Group Communication Apprehension*	I am calm and relaxed while participating in group discussions.
Animated	My eyes reflect exactly what I'm feeling when I communicate.
Animated	I tend to constantly gesture when I communicate.
Animated	I am very expressive nonverbally in social situations.
Animated	I actively use a lot of facial expressions when I communicate.
Wit	When I am anxious, I often make jokes.
Wit	I often make jokes in tense situations.
Wit	When I embarrass myself, I often make a joke about it.
Wit	When someone makes a negative comment about me, I respond with a witty comeback.
Wit	People think that I am witty.
Articulation*	When speaking, I have problems with grammar.
Articulation*	At times, I don't use appropriate verb tense.
Articulation*	I sometimes use one word when I mean to use another.
Articulation*	I sometimes use words incorrectly.
Articulation*	I have difficulty pronouncing some words.
Industry	In which industry do you currently work
Function	What is your current job function
Frequency of email use	How frequently do you use email
Frequency of video conferencing	How frequently do you use video conferencing
Frequency of text	How frequently do you use text messaging
Frequency of conference calls	How frequently do you participate in conference calls (via telephone
Frequency of instant messaging	How frequently do you instant messaging
Frequency of face to face meetings	How frequently do you participate in face to face meetings
Computer Experience	How would you describe your level of computer experience
Age	What is your age

* Reverse Coded Item

Appendix C: Simulation Code

```
;;The code below was written for NetLogo version3.15

globals [numfrogs numturtles numchicks test1 test2 test3 test5 needneighbor2
clock number var1 var2 numberCultures cultureList culturelista culturelistb
culturelist2 culturelista2 culturelistb2 other player numberculturesaccess
numberculturesNoAccess MyListNW MyListNE MyListSW MyListSE
DomCultureSize DomCultureSize2 DomCultureSizeAccess
DomCultureSizeAccess2 DomCultureSizeNoAccess DomCultureSizeNoAccess2 ]
patches-own [r g b MyList Mycount  PlayerList Matches OpeningsList ListSize
OpeningsIndex FeaturesIndex Trait needneighbor]
breed [ rabbits ]
breed [ dogs ]
breed [ cats ]
breed [ frogs ]
breed [ mice ]
breed [chicks]


to setup

 ;;clear the model
 ca
 ;; define variable number as the number of patches with access
 set number  (percent-with-access * count patches) / 100
 set var1 1
 clear-turtles


 ;; randomly assigns access to patches accounting for duplicate assignments
 while [var1 <= number][
  ask one-of patches [
  if not  any? chicks-here
  [sprout-chicks 1[
  set color white
  set size .5]
  set var1 var1 + 1]]]


  ;; randomly assigns invisible frogs to mark no access patches)
  ask patches
  [if not any? chicks-here
  [sprout-frogs 1 [
  set size .5
  set hidden? true]
  ]]
```

```
 ;;; this will set the grid 4 starting cultures in quadrants
 ifelse not random_start
 ;; NW QUAD
[  set MyListNW []

   ;;initializes the list
   while [features > (length MyListNW)]
   [
    set MyListNW lput random(traits) MyListNW
   ]
  ;; NE QUAD
   set MyListNE []

   ;;initializes the list
   while [features > (length MyListNE)]
   [
    set MyListNE lput random(traits) MyListNE
   ]
   ;;SW QUAD
  set MyListSW []

   ;;initializes the list
   while [features > (length MyListSW)]
   [
    set MyListSW lput random(traits) MyListSW
   ]
   ;; SE QUAD
   set MyListSE []

   ;;initializes the list
   while [features > (length MyListSE)]
   [
    set MyListSE lput random(traits) MyListSE

   ]



ask patches with  [pxcor <= 9 and pycor >= 10]
 [set MyList MyListNW
 doColor]
;; NE QUAD
 ask patches with  [pxcor >= 10 and pycor >= 10]
 [set MyList MyListNE
 doColor]
 ;;SW QUAD
 ask patches with  [pxcor <= 9 and pycor <= 9]
 [set MyList MyListSW
 doColor]
```

```
 ;;SE QUAD
  ask patches with  [pxcor >= 10 and pycor <= 9]
 [set MyList MyListSE
 doColor]
 ]
[
 ;;issue a set of initialization commands to all patches in the model
 ask patches
  [

  ;;creates a list object for storing traits
  set MyList []

  ;;initializes the list
  while [features > (length MyList)]
  [
   set MyList lput random(traits) MyList
  ]
  doColor
  ]
  ;;calls the color method for initial show of model
  ]

 ;;set the global clock to 0
 set clock 0

end

;;Main Method of the model
to go
 ;;Issue a set of commands to all patches
  countcultures
countacccesscultures




 ask  patches [match  doColor]
 ask rabbits [die]
 ask dogs[die]
 ask cats [die]
 ;;increment global clock
 set clock clock + 1

 ;;update graphs
 ;do-plots
 ;do-histogram
 ;; these rabbits are hidden elements used to report on the number of cultures
 create-custom-rabbits numbercultures [set hidden? true]
 output-print numbercultures
 print numberculturesnoaccess
```

```
end

;;Each Patch executes the following procedure
to match
 ;;restset the variables used in this procedure
 set Mycount 0;
 set Matches 0;
 set OpeningsList []
 set ListSize -1
 set OpeningsIndex -1
 set FeaturesIndex -1
 set Trait -1
set needneighbor true
  set numturtles count turtles
   set numfrogs count frogs
   set numchicks count chicks

;; for patches with access,
;; determine if they will interact w/ physical or virtual neighbor

ask self
  [if any? chicks-here and not any? frogs-here
   ;; you have access randomly select a virtual or physical neighbor to interact
with
   [ set test1 true

   set test2 random 8 + 1
   if test2 <= virtual-neighbors
    [while [needneighbor = true]
     [ask one-of patches
      [if any? chicks-here and not any? frogs-here
       [set player self
       set test3 true
       set needneighbor false
       set needneighbor2 needneighbor]
      ]
     ]
    ]


   ]
 ;; for patches without access,
 ;; they simply interact witha physical neighbor
ask self
   [ if needneighbor
 [set player one-of neighbors
 set test5 true
 set needneighbor2 needneighbor]]
```

```
 ;;get the neighbor's list of traits
 set PlayerList value-from player [MyList]

 ;;compare my traits with my neighbor's traits
 foreach MyList
 [
  ifelse (item Mycount PlayerList = ?)
  [
    ;;record count of matches
    set Matches Matches + 1
  ]
  [
   ;; record the index of non-matches
    set OpeningsList lput Mycount OpeningsList
  ]
  ;;keep track of how what index in the list we are at
  set Mycount Mycount + 1
 ]

 ;;turn the count of matches into a fraction
 set Matches (Matches / features)

 ;;interact with probability equal to similarity, this is an addition to Cornell model
 if ((Matches >= ((similarity / 100))) and (Matches < 1))
 [
    set ListSize length OpeningsList;; size of index list
    set OpeningsIndex random(ListSize);; random spot in index list
    set FeaturesIndex item OpeningsIndex OpeningsList ;; find index to use
    set Trait item FeaturesIndex PlayerList ;; use index to get Trait

    ;;copy a randomly selected trait to one of the non-matching traits
    set MyList replace-item FeaturesIndex MyList Trait
 ]
end

;;This uses the values of the traits to determine the coloring of the patches


to randomize-position
 setxy random-float world-width
      random-float world-height
end


to doColor
    set MyCount 0
  foreach MyList
  [
     if (MyCount = 0)
      [set r  ? / traits]
     if (MyCount = 1)
```

```
      [set g  ? / traits]
     if (MyCount = 2)
      [set b  ? / traits]
      set MyCount MyCount + 1
     ]
   set pcolor rgb r g b
end




;;Put into Go

 ;;A global command that selects a single patch to execute
;; if (noise > random(1000))
;; [
;;   ask random-one-of patches [perturb]
;; ]


;;Randomly replaces a feature
to perturb
   set FeaturesIndex random(features)
   set Trait random(traits)
   set MyList replace-item FeaturesIndex MyList Trait
end


;; determine how many unique cultures presently exist
to countcultures
 set CultureList []
 set cultureList2 []
  set culturelist values-from patches [MyList]
  set culturelist2 values-from patches [MyList]
  set culturelist remove-duplicates culturelist
  set numbercultures length culturelist
  set DomCultureSize2 first modes culturelist2
  show reduce [ifelse-value (?2 = DomCultureSize)[ ?1 + 1][?1]](fput 0
culturelist2)
  set DomCultureSize reduce [ifelse-value (?2 = DomCultureSize2)[ ?1 +
1][?1]](fput 0 culturelist2)
end

;; determine how many unique cultures exist among those with  and without
access
to countacccesscultures
;;determine how many unique cultures exist among those with   access
ifelse percent-with-access > 0
  [ set cultureLista []
   set cultureLista2 []
```

```
  set culturelista values-from patches with [(any? chicks-here) and not (any?
frogs-here)] [MyList]
   set culturelista2 values-from patches with [(any? chicks-here) and not (any?
frogs-here)] [MyList]
  set culturelista remove-duplicates culturelista
  set numberculturesaccess length culturelista
  set DomCultureSizeaccess2 first modes culturelista2
  set DomCultureSizeAccess reduce [ifelse-value (?2 = DomCultureSizeAccess2)[
?1 + 1][?1]](fput 0 culturelista2)]
  [set DomCultureSizeAccess 0
   set numberculturesaccess 0]

 ;; determine how many unique cultures exist among those without access
 ifelse percent-with-access < 100
[ set cultureListb []
 set cultureListb2 []
   set culturelistb values-from patches with [any? frogs-here] [MyList]
   set culturelistb2 values-from patches with [any? frogs-here] [MyList]
  set culturelistb remove-duplicates culturelistb
   set numberculturesnoaccess length culturelistb
   set DomCultureSizenoaccess2 first modes culturelistb2
    set DomCultureSizenoAccess reduce [ifelse-value (?2 =
DomCultureSizenoAccess2)[ ?1 + 1][?1]](fput 0 culturelistb2)
   ]
    [set DomCultureSizenoAccess 0
   set numberculturesnoaccess 0]
end


 to-report max-items [the-list]
report max map [count-items ? the-list] remove-duplicates the-list
end

to-report count-items [i the-list]
report length filter [? = i] the-list
end

 ;;to determine the size of the dominant culture from the entire population
;;to getdomculture
;;set culturelist []
;;set culturelist values-from patches [MyList]
;;set DomCultureSize  first modes culturelist
;;end

;;to determine the size of the dominant culture amoung the with and without
access groups
;;to getdomaccessculture
;;set cultureLista []
;;set culturelista values-from patches with [(any? turtles-here) and not (any?
frogs-here)] [MyList]
;;set DomCultureSizeaccess first modes [culturelista]
```

```
 ;;set cultureListb []
 ;; set culturelistb values-from patches with [any? frogs-here] [MyList]
  ;; set DomCultureSizenoaccess first modes [culturelistb]
;; end




to-report about-color [n col]
report ((n > (col - 5)) and (n < (col + 5)))
end

to do-plots
  if not plot-groups? [ stop ]
  set-current-plot "Patch Colors"
  set-current-plot-pen "color5"
  plot  count patches with [about-color 5 pcolor]
  set-current-plot-pen "color15"
  plot  count patches with [about-color 15 pcolor]
  set-current-plot-pen "color25"
  plot  count patches with [about-color 25 pcolor]
  set-current-plot-pen "color35"
  plot  count patches with [about-color 35 pcolor]
  set-current-plot-pen "color45"
  plot  count patches with [about-color 45 pcolor]
  set-current-plot-pen "color55"
  plot  count patches with [about-color 55 pcolor]
  set-current-plot-pen "color65"
  plot  count patches with [about-color 65 pcolor]
  set-current-plot-pen "color125"
  plot  count patches with [about-color 125 pcolor]
  set-current-plot-pen "color85"
  plot  count patches with [about-color 85 pcolor]
  set-current-plot-pen "color95"
  plot  count patches with [about-color 95 pcolor]
  ;; this updates a second plot which shows the number of unique cultures over
time
 set-current-plot "Unique Cultures"

 plot numbercultures

end

to do-histogram
set-current-plot "culture-distribution"
set-plot-pen-mode 1
histogram-from patches [pcolor]
end
```