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Completed Research

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Abstract

The breakthrough idea of technology dependence is developed from mass communication theory as an enhancement to the evolving literature on IS Continuance. Unlike prominent constructs in the continuance literature, dependency as adapted for use here involves conscious user recognition of the benefits from and motivations for technology use, which stands in contrast to typical continuance constructs that presume routinized and nonconscious usage patterns. This study develops, tests and explains emerging dimensions of technology dependency in the context of mobile 3G handset users in a university workplace community. Results provide the basis for development of measures and hypothetical relationships with related variables for future research, and provide a valuable new variable for inclusion in the IS Continuance literature stream.

Key Words: End-user computing, Exploratory research, Individual impact

Introduction

It is a well-established in our literature that long-term success of a technological innovation depends upon its adoption *and* continued use (Bhattacherjee 2001). As a factor leading to continued use, we explicate the construct of Technology Dependence in this paper. Technology dependence is, specifically, *the reliance that arises in users from motivated use of technology over time for specific goal-oriented purposes* (Sandelowski 1993). This could easily be construed as habitual use in the context of the extant IT literature on continued use (e.g., deGuinea and Markus 2009; Jasperson, Carter and Zmud 2005; Kim and Son 2009; Limayem, Hirt and Cheung 2007). Yet, dependency is not the same as habitual use. Habitual use is a conditioned behavioral response; *dependency*, however, is an evaluative response to a prized technology based on its success use for solving problems over time.

We think that habitual use can arise *from* dependency, in the process of technology users becoming conditioned as through repeated experience with the solution of a problem through specific technological means. For example, a 3G smartphone user will depend on his/her phone for organizational information and data support on the fly, and this ready reliance upon a smartphone to stay connected to email and server-side information technology resources can lead to a dependence arising from the process of relying on the phone for informational support at work. In other words, the tendency for a user to depend on a specific technology is distinct from their actual technology use practices. On the one hand there is the motivation for technology use, which is typically a reasoned process (Limayem et al. 2007), and on the other hand, there is subsequent technology usage behavior, which can certainly become automated over time and with repeated experience (de Guinea and Markus 2009). This study examines the motivation for continued technology use in the form of pre-existing dependencies on task-specific technologies oriented to accomplishing certain tasks and solving specific problems. We propose to explore the dimensionality of technology dependence upon mobile 3G devices, and our research question is "what are the specific dimensions of device dependence characteristic of 3G mobile devices used as an email access modality for organizationally-sponsored email services?"

Our task is to understand when and how dependency upon a specific technology for purposes of solving a specific problem arises. Our related research goal is to explore the dimensions of technology dependency in the specific context of mobile technology users in an organizational context in an effort to specify the domain of the construct in preparation for future testing and independent confirmation.

The recent nation-wide service outage for the BlackBerry mobile device provides an interesting case in point for the managerial relevance of the sort of dependencies that arise in response to continual goal-oriented use of a technology, and the subsequent disappointments and discontinuities that occur in the lives of users when the technology fails to function as expected. This is the basis of our study here: to explore and explicate the concept of Technology Dependence as seen through the lens of the reliance that a group of mobile device users have for their device. We know that long term viability of a system depends on it continued use (Limayem et al. 2007), and to the extent that continuation can arise from dependence, we consider this an important construct for study.

The paper begins with a review of the Media Dependency in the mass communication literature and generates a synthesis of generalizable findings through the related concept of Affinity for the Computer, which has already been demonstrated to have relationships with technology user motivations in the Information Systems literature (e.g., Stafford and Stafford 2002). Then, we describe the initial stages of surveying the domain of the construct of technology dependence in the specific context of mobile through careful consideration or prior research on media dependence. Lastly, we empirically identify and distill theoretically-consistent dimensions of technology dependence to guide further research on the nature and measurement of dependence in technological contexts, along with related implications for the concept of technology dependence in the ongoing study of motivated technology use in the workplace.

Literature Review

We suspect that dependency evolves over time from a conscious assessment of problem and solution vectors, to a routinized application of the solution "that worked last time." We consider technology dependence initially to be an aspect of *learned* needs that eventually give rise to long term habitual use, much in the sense that Lemayim et al. (2005) construe reliance as relating to conscious intentions to use a technology, played out over time until the process becomes habituated. Dependence arises from the satisfaction of needs over time, but it is *not* an unaware process, at least not as it directly manifests itself to the perceiver. In line with the applications of the Expectation-

Disconfirmation paradigm of consumer satisfaction (Oliver 1980), as applied to IS Continuance research (e.g., Bhattacherjee 2001), we note that the key difference between this nascent construct of technology dependence and the established concepts of habit and automaticity found in the IS continuance literature has to do with what transpires when a need is *not* met, as was the case in the recent BlackBerry service outage in the United States market. In short, users may routinely use some technology in service of a commonly-met need, such as a 3G mobile phone to connect to Exchange Server email services, but they readily understand how dependent they are upon a given technology when it fails or is not available to solve its commonly linked problem.

Technology dependence is not the same as a habitual technology use process, as described in de Guinea and Markus (2009), who posit that habitual IS use arises from factors that are automatically triggered by environmental cues (something that takes place outside of conscious direction). Dependence is an evaluative factor that arises in the proximity of failure of an IS to meet a need, as best characterized in the Expectation-Disconfirmation paradigm from consumer behavior research (Oliver 1980). Dependence arises from recognition of the lack of need-satisfaction, whereas habit speaks to the routine and successful use of an IS. They are conceptually similar but operationally distinct concepts in the overall realm of IS continuance research.

In contrast to a learned dependence, goal-directed IS continuance behavior is conceptualized as not necessarily conscious (de Guinea and Markus 2009, p. 434); by contrast, we consider dependency to arise from technology use that corresponds to specific and known conscious gratifications. Hence, the emergent concept of technology dependency, which we shall explicate here, is a conscious process in initial evaluations of technological efficacy in problem solving, and again at the point that the absence of the ability to solve a given problem forces conscoi9us recognition of the dependency state. To be clear, the impact of dependence upon a technology after repeated, motivated and conscious use over an extended period of time may not be always entirely accessible to the perceiver; but, the process of choosing to use a given technology to meet a need, on a repeated basis over time, *is*. Hence, it is a conscious process in its inception. Habitual use is operationalized as arising from behaviors that become automatic due to learning, over time (Limayem et al. 2007). This stands in stark contrast to the avowed and conscious recognition by a user that a technology is useful for a specific problem-solving scenario, has become more so with repeated use, and is explicitly recognized as being depended upon in its absence, which is the basis of what dependency constitutes, in our mind. To this extent, we conceptualize dependence as much like intention, though perhaps more needful than rational. None-the-less, it is conscious and directed as a mental process. Technology dependence may not always be reasoned, but it is consciously recognized, is our sense.

The successful attainment of motivated goal achievement leads to the expectation that the technology will lead to goal attainment on a continual basis. This is the essence of Technology Dependence. The nascent theoretical concept of Technology Dependence arises from a venerable and robust mass communication theory known as Media Dependence (cf., Ball-Rokeach 1976; 1985; DeFleur and Ball-Rokeach 1989). Several decades of successful work on the nature of media user gratifications, motivations and expectations with regard to the attainment of goals through media choices illuminates our investigation of 3G mobile devices and how users come to be similarly dependent upon them.

Media Dependency

A communication medium is, among other things, a potent social *information system*, useful for resolving ambiguity (Ball-Rokeach and DeFleur 1976). As people use a medium for informational purposes toward the goal of resolving ambiguity, they become dependent upon the medium and come to rely on it to lead to the solution of similar problems in the future; this is not so much a focus on the medium, itself, but on the information that is carried by it (McDonald 1983). Media Dependency deals with the motivated interaction between users and their media and devices (e.g., Ball-Rokeach and DeFleur 1976, p. 8). The careful adaptation of theoretical concepts and constructs from reference disciplines can be a useful approach for understanding conceptually similar processes in IS contexts, as was previously demonstrated in the application of the related Uses and Gratifications paradigm to understanding motivations for Internet use (e.g., Stafford, Stafford and Schkade 2004), in the adaptation of Reasoned Action precepts to IT Acceptance (Davis 1989) and the adaptation of Media Dependency constructs to the conceptualization of technology dependence is utilized in similar fashion, here.

The interactive perspective of media dependence is particularly useful in the world of technology, where users are regularly and directly engaged with their multimedia communication devices; that is because the concept of dependence appears to be a combination of reliance (orientation to a source for procurement of desired information) and frequency of use (e.g., McDonald 1983). Hence, dependency can be said to arise when a user regularly and frequently goes to a particular medium of communication for the information deemed necessary to cope with

ambiguous situations in daily life. In the business world, the concept of a regular and trusted "go-to" is not untoward in regard to expressing the core nature of dependency in this regard.

Degree of use is another analogy for reliance (Miller and Reese 1982), in the sense that the more one uses a particular information channel, the more one comes to rely on it for similar solutions to life's problems in the future. Hence, dependency for an information and communications technology can be found in the degree to which the ICT is useful in providing informational solutions for the user, and to the extent that the user comes to regularly count upon this particular ICT on an ongoing basis for similar solutions, going forward.

Ball-Rokeach (1985), a pioneer in explicating the Media Dependency theory of mass communications, considers dependency to arise from the capability of an individual to attain important goals based on (or, contingent upon) the information resources of the media system in question. In this sense, the dependency upon a given medium arises from the capability of the communication system to create, gather, process and disseminate goal-related information. To that end, much of dependency is assumed to arise from the structural interdependence between a medium and other social systems (Ball-Rokeach 1985, p. 489). In this view, dependency relationships can arise from both content-based and social-based information and communication technology (ICT) gratifications (e.g., Stafford et al. 2004), whereby users are either informed by, informed about, or connected to important others by the technologies they rely upon and are motivated to continue to use.

Media Dependency is conceptually related to the concept of understanding user motivation by way of studying what people do with media, in the sense that dependency arises from understanding goal-oriented use. A goal (i.e., a sought gratification) leads to motivation, and sustained motivation to use a medium in satisfaction of some need subsequently leads to dependency (e.g., Ball-Rokeach 1985). This view is echoed by Rubin and Windahl (1986, p. 187), who specify that a need gives rise to sought media-related gratifications, which then, over time in the satisfaction of the need through obtainment of the gratification, leads to dependency. Dependency, in this sense, arises from the medium's juxtaposition between the individual and the social groups to and from which the individual wishes to communicate information; this gives rise to a facilitational sense for the dependency relation.

Researchers studying dependencies in the mass communications literature have traditionally categorized dependency relations into three broad groups (Grant, Guthrie and Ball-Rokeach 1991): play (either solitary or social, where the individual derives recreational gratifications from the medium depended upon), orientation (either action- or interaction-oriented, where the individual derives support for personal decision making or relationships with other people, respectively), and understanding (either self- or social-understanding, where the individual derives knowledge of one's self or one's relations through the medium depended upon). Though this tripartite characterization of dependencies has been leveraged in studies that develop dependency measures for assessing individual coping reactions to threats via dependency relations (e.g., Loges 1994), the problem-solving orientation of dependency relations is more typically applied to scenarios in which an individual is dependent on a medium for solving problems related to membership in larger social groups (cf., Ball-Rokeach 1985; Halpern 1994; Morton and Duck 2000). Indeed, the predominant characterization of communication media in the dependency research is that of an information system (Grant et al. 1991), which lends itself nicely to an adaptation of media dependency theory to an emerging theory of dependency upon technologically-mediated sources of communication and information -- to wit, Technology Dependency.

Toward A Theory of Technology Dependence

In view of the specification of dependency relations in the mass media as instances of gratifications supplied by an information system (Grant et al. 1991), the adoption of the media dependency perspective to the consideration of motivated usage of ICTs such as smart phones seem particularly apt. Media motivation theories have been successfully adapted to studies of ICT use in the past (e.g., Stafford et al. 2004), and such successfully-adapted theories (i.e., Uses and Gratifications theory) have strong synergies and theoretical relationships with the present dependency framework under consideration here (cf., Rubin and Windahl 1986).

A specific theory of technology dependence has already been iterated in the medical literature. Sandelowski's (1993) perspective of technology dependency has to do with the subsequent reliance that patients have for certain life-sustaining and life-extending technologies after being iatrogenically prescribed by their physicians. Though it is more difficult to reconcile a view of technology as a life-sustaining element of care, versus a problem solver in an information management and communication system, the sense of problem-solving through the application of technology spans both views, as does the eventual evolution of a state of dependence upon the regular problem solving capabilities of the technologies in question for their users. Moreover, the medical view of technology

dependence is refreshing in one particular respect: it specifically acknowledges the culturally mediated role that technology plays in all aspects of our lives, as an essential part of the Western belief system of a technological reality (Sandelowski 1993, p. 38). Technology figures prominently in modern life; in other words, whether it serves to maintain health, or social ties, or to support personal decisions, across varying contexts, we are increasing dependent upon the technologies that surround us in our modern world (McCune 1999).

One such technology is the Internet (e.g., Patwardhan and Yang 2003; Stafford et al. 2004). Another is represented by the computer systems with which we do our work (e.g., Stafford and Stafford 2001; Viator and Curtis 2001). Certainly, the existing view of technology dependency (i.e., Sandelowski 1993) shares many of the important aspects of the model we wish to evolve from the media dependency theory perspective, notably the notion of organized and systemic social support via technological utility, and a problem-solving orientation toward the employment of technological solutions. However, recent adaptations of media dependence principles (e.g., Patwardhan and Yang, 2003) seem to demonstrate its particularly applicability to ICT formats, in contrast to the medical contexts represented by Sandelowski's competing explication of the emerging theory.

The fact remains that an evolving Theory of Technology Dependency should likely expand upon the robust and long-standing theoretical base of media dependence, given the many and compelling similarities that exists between modern information technologies and mass media systems (e.g., Armstrong and Hagel 1996; Palmer and Griffifth 1998; Stafford et al. 2004)..

The problem with emerging views of technology dependence based upon the media dependency heritage in mass communications is conceptually similar to the problems faced in prior adaptation of U&G theory to ICT analysis. That is, researchers have been adapting and utilizing measures that were developed in different contexts for the study of different technologies, when what was really required was the development of technology-specific measures under the guidelines of the adapted theory, rather than simple re-use of prior measures borrowed from mass communications studies (cf., Stafford and Stafford 2002). In essence, the one example of mass communication media dependence adapted to the context of Internet use (e.g., Patwardham & Yang, 2003) comprises a simple reiteration of Ball-Rokeach's 18-item news media dependency instrument (cf., Grant et al. 1999; Ball-Rokeach and DeFleur 1976), which focuses on play, orientation and understanding, and which considers predominantly recreational and social use of [the technology]. We tend to think that a concept of technology dependence that coincides with IT continuance principles will apply to work-related needs as much as recreational requirements, in order to be relevant to IS researchers interested in organizational contexts.

Our feeling is that work-related technology dependency will not map as directly to the play and orientation constructs of the original 3-dimension 18-item Ball-Rokeach inventory that has been used in the past to assess recreational and entertainment uses of media, and that it would be advisable to carefully explore the dimensionality of technology dependency measures drawn from reference disciplines. As was demonstrated in adaptations of Uses and Gratifications from mass communications theory to Internet research, it is clear that measures designed for the specific technology at hand under developmental precepts of prior theory are most appropriate for purposes of internal validity (Stafford et al. 2004, p. 268). That is the process that begins here with this research, which has the goal of developing a list of items and distilling them to a coherent set of dimensions and associated indicators useful for further research and instrument construction.

Broad Dimensions of Dependence

In the prior research in mass communications, three broad areas are considered in regard to the evolution of dependency relations (Rubin and Windahl 1986): 1) needs, which are satisfied by 2) gratifications, satisfaction of which leads over time to 3) dependence. Since the media dependency construct in mass communication has generally been considered to be closely associated with gratifications for media use, the development approach that led to recently-developed Internet Uses and Gratifications measures (Stafford et al. 2004; Stafford and Stafford 2002) should be considered in the construct identification and measure development process as part of new theory development. There is one other measure derived from mass communications research and applied to technology studies that is also conceptually similar to what might characterize a technology dependence inventory, and that is the Affinity for the Computer scale (Stafford and Stafford 2002). This measure assesses how well users would weather the lack of their computer resources as part of measuring appreciation for computing technology, and this particular quality seems quite closely related, conceptually, to the concept of technology dependence. Hence, this pre-validated inventory should also be useful for comparative purposes in the exploration of technology dependency dimensions.

Dimensions of Assessing Technology Dependence

In view of the popularity of re-use of existing scales, a good starting point for the development of technology-specific constructs would be to revise applicable descriptive statements used previously to assess media dependency in new terminology suited to the assessment of the technology under consideration here (i.e., 3G smart phones, workplace contexts). To that end, we began domain sampling for questionnaire construction with a broad range of candidate items derived from prior media dependency studies that assessed the broad motivations and uses of media technology. Essentially, we took declarative statements from prior studies of media, and reworded them in minor fashion to be applicable to the mobile technology context. This was not particularly difficult, as media dependency researchers had already conceptualized their media as information systems.

The research team collaborated in a modification and revision process by which we developed consensus on phrases and wording choices from prior media dependency measures that would characterize smart phone technology use as opposed to the original media dependency wordings regarding news or entertainment media use. In the process, great care was taken to preserve the semantic meaning of the comparative and declarative aspects of the original descriptive items in adaptation to the new technological context. Where candidate scales did not exist, but thematic guidance was available for item development, we generated question wording that matched the themes expressed in the prior studies from media dependency, as adapted to a technological context. The present study would then serve as an initial pre-test of these specific items.

As shown in the Appendix, we used the characterization of depended-upon media from Ball-Rokeach (1985) as those technologies that are actively used to create, gather, process and disseminate information, from which we adapted eight candidate items. Also, from Ball-Rokeach's (1985) characterization of dependency arising from the control a channel has over messages, we elicited four items, while her characterization of dependency arising from interdependent relations between a medium and social systems led us to generate an additional five items.

Moy, Torres, Tanaka and McClusky (2005) suggest dependence can be discerned by the degree to which a user expresses specific reliance on a medium, or expresses non-reliance on alternatives. Moy et al. (2005) also considered that reliance is evidenced by a concentration of attention upon a medium. These considerations led to generation of ten additional items. Skumanich and Kintsfather (1998) as well as Moy et al. (2005) suggest that cognitive arousal increases with dependency on a medium; three items designed to assess cognitive attention were developed for this dimension.

Miller and Reese (1982) considered that degree of use indicated reliance, from which three candidate scale items were generated, while the Morton and Duck (2000) characterization of perceived helpfulness as an indicator of dependence permitted the development of six items assessing how helpful BlackBerry devices were in the workplace. The DeFleur and Ball-Rokeach (1989) perspective suggested item elicitation for dimensions of information gathering, processing and transformation, and dissemination, while McDonald (1983) considered that a simple declaration of primacy for a medium indicated dependency, which led to the elicitation of a single additional item.

Loges (1994) expanded Ball-Rokeach's original inventory from 10 to 18 items, in order to express a combination of needs, goals and dependencies. Reworded to reflect the technological context of the study, all 18 were included. Lastly, Moy et al.'s (2005) ranking of alternatives approach suggested a rank ordering task in which three similar technologies, the smart phone, and both desktop and webmail-based email clients, could be ranked in comparison. The theoretical expectation would be that the depended-upon technology would rank highly against alternatives.

Each of these groups of candidate items were included in a questionnaire along with the established Affinity for the Computer inventory for nomological comparison in analysis. The complete list of items is displayed in Appendix 1.

Theoretical Expectations for Candidate Items

This is an exploratory study of technology dependency dimensions, designed to begin the process of item elicitation for construct identification and potential scale construction for emerging dimensions of technology dependency, based on a study of a university smart phone user group which uses its devices for work support and communication. Minimal work in this direction (i.e., the adaptation of media dependency concepts to technology dependency contexts) has been done, but it would be useful to benchmark any candidate scale items and their underlying dimensions with the limited results that do exist for testing dependency relations in regard to technology use. Hence, any dimensions identified here in regard to user dependence on smart phones should also relate positively to scales designed to assess Affinity for the Computer (e.g., Stafford and Stafford 2002), particularly as

these computer affinity items are worded to assess a user's response to the *absence* of the relied upon computer technology, which is a close match to the theoretical underpinnings of the dependency construct as a perception that exists in response to the *lack* of need-satisfying capabilities, which was developed in the introductory passages of this paper.

Method

With the questionnaire developed from an inventory of adapted scale items and items developed from thematic dimensions in prior studies of dependency, we solicited a smart phone user group among staff and faculty members at a major urban University in the south to complete a survey on their uses and motivations for use of their smart phone device. The survey was hosted on the popular Survey Monkey web site. 182 usable responses were obtained out of a group of 820 smart phone users, for an effective response rate of 22%. Although the response rate was low, whe individual groups of survey items were independently assessed, the normative requirements expressed by Hair et al. (1995) for survey size per items of analysis were met.

Data collected at the Survey Monkey site was downloaded in the form of spreadsheets and input to SPSS 15 for exploratory analysis. Initially, thematic groupings were subjected to principle components analysis with varimax rotation in order to explore potential dimensionality of the items for construct identification. Analysis used the rubric for item retention of strong on-factor leadings, typically in the range of .5 or nearly approaching that level, to indicate a strong on-factor response in analysis. This is consistent with typical practice, when one wishes to assure strong and significant loadings (Hair, Anderson, Tatham and Black 1995). Cross-loading variables were not interpreted.

Figure 1: Scree Plot of Factors
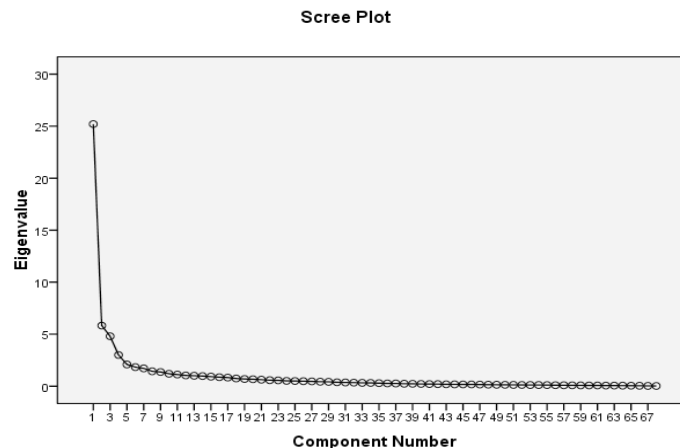
Results

Of the list of candidate items generated for the questionnaire, as shown in the Appendix, 13 factors with eigenvalues greater than one were identified. In subsequent scree plot analysis, shown in Figure 1, diminishing returns on explained variance indicated a 4 factor solution for interpretation. As can be seen, a rapidly diminishing efficiency in explanatory power occurs after the 4th factor, even though a great number of the disregarded factors exceeded an eigenvalue of 1.

Factor Interpretation

The initial and largest factor explained 37% of variance, and as indicated in Table 1, below, was characterized by strong loading items in terms that suggested a theme related to information utility, in accordance with the .5 benchmark of Hair et al. (1995). Using the mobile device to create, organize and analyze useful information speaks to a strong information utility, and reliance would likely be strongly related to the uses and gratifications that information in the workplace has for the user.

The second identified factor explained 8.6% of variance, and we thematically characterized by social needs. Using the device to communicate with others, stay in touch with friends, family, and recognizing that others use the device

to stay in touch with oneself is characteristic of the concept of "people" in our analysis. The third factor was clearly a work factor, indicated by strong loadings from items that deal with the important of the device in workplace communication, providing access to work-related information and keeping one connected with workplace colleagues. Though this factor only explained 7% of variance, its thematic focus is quite instructive for diagnosing the needs and dependencies that users might have for their mobile devices in the workplace.

The last factor retained in the analysis explained 4.4% of variance and had to do mostly with fun and recreation. This is not entirely surprising, as the only other dependency study to focus on information technology (e.g., Patwardham and Yang 2003) was primarily focused on recreational use. Characterized by strong-loading items that spoke of having fun with friends and family, and relaxing leisure activities achieved with the aid of technology, this factor was most similar to the recreational dependency characteristic of the prior Internet use study of Patwardham and Yang (2003).

Means Analysis

The factor loading matrix tells part of the story. More can be learned by looking at how strongly each individual variable on each factor is rated, through examining the mean scores per variable across each factor. Shown in Table 2, this simple by useful analysis is illuminative.

In Factor 1, the Information dimension, we see mean scores on each of the 7-point rate items that are positive, but not strongly so, providing values in the range of 5 on a scale of 7. This can be taken as an indication that the respondents generally agree about their dependence on the mobile devices for information, to be sure. But, it may also be indicative of the fact that the mobile device was not the exclusive information access device for this user group. In fact, the mobile device tended to duplicate the desktop client access to the Microsoft Exchange server for email provision purposes, and users could view their mail on the go with the mobile handset, or at the desk with their personal computer. It is the second factor that the strongest scores are seen, and the utility of a mobile 3G handset for staying in touch with people during the workday is clear and apparent. The social utility of ICTs has been clearly established in the Uses and Gratifications literature that examines Internet user motivations (Stafford et al. 2004), and a clear social factor of motivation is readily apparent there, as is here. Users depend on their technology to keep them in touch, with others in general, and with friends and family in specific.

By contrast to the performance of the general People factor, the dependence on the device to keep in touch with coworkers is not nearly as high, as can be seen in means analysis of the Work factor (Factor 3). Demonstrating some of the lowest mean scores in the group of four factors, this factor provides variable scores that are at or below the neutral point, by in large. It is instructive to note, for example, that the respondents mildly disagreed with the statement that the device was their primary channel of communication in the workplace. This simply reinforces the ancillary nature of a 3G handset in the workplace: useful on the go, but an adjunct to the desktop computer, perhaps. While scores indicate a mild agreement with sentiments about the device keeping one in touch with coworkers, superiors and others important to the flow of work, mean scores that are at or slightly above the scale neutral point are mooted by fairly wide standard deviations exhibited for each variable. It seems that the topic of work use resonates with this user group, as it should, since the mobile devices were identified by their authorization for Exchange Server access for email in this survey, but none-the-less, a score of 5.78 for the variable, "Compared to other technologies, my device is my primary source of information in the workplace," is indicative of a certain degree of dependence, though perhaps grudgingly admitted. Clearly, these users had multiple sources for communication and information access; the mobile handset was a portable and convenient access venue, but one of several, it would seem.

Table 1: Factor Loadings for Dependency Dimensions

Factor 1 – 37% of Variance **Theme "Information"**	**Factor 2 - 8.6% of Variance** **Theme "People"**
BR85No1 – I use my device to create information (.781)	BR85No6 – I use my device to communicate with others (.668)
BR85No3 – I use my device to organize information (.678)	BR85No13 – My device puts me in touch with friend and family (,722)
BR85No4 – I use my device to analyze information (.580)	BR85No16 – Other people depend on my device to stay in touch with me (.587)
DBR89No3 – I create information using my device (.806)	
DBR89No4 – My device helps me create information that is useful to me (.749)	Moy05No2 – I use my device a lot (.636)
DBR89No5 – I use my device to collect and organize information (.748)	Moy05No3 – My device is important to me (.687)
DBR89No6 – I use my device to analyze and transform information I collect (.684)	Moy05No5 – I rely on my device (.559)
DBR89No8 – My device is useful for organizing and storing information I collect (.703)	DBR89No11 – I use my device to provide information to my friends and family (.448)

Factor 3 – 7% of Variance **Theme "Work"**	**Factor 4 – 4.4% of Variance** **Theme "Fun"**
BR85No8 – My device is the primary channel of communication in my workplace (.576)	Loges94No7 – Having fun with family and friends (.597)
BR85No9 – My device is an important channel of communication in my workplace (.843)	Loges94No8 – Giving me something to do with my friends (.643)
BR85No10 – My device controls my access to work-related information (.546)	Loges94No9 – Participating in events I really enjoy without having to be there (.534)
BR85No11 – My device facilitates my access to information that is important to me in my work (.708)	Loges94No10 – Unwinding after a hard day of work (.770)
BR85No12 – My device puts me in touch with co-workers who help me do my work (.841)	Loges94No11 – Relaxing when I am by myself (.831)
BR85No14 – My device keeps me in touch with my supervisor (.662)	Loges94No12 – Having something to do when nobody else is around (.789)
BR85No15 – My device keeps me in touch with employees who report to me (.730)	Loges94No16 – Deciding where to go to obtain services such as health, financial or household (.514)
MD00No3 – My device helps me to learn what I have to do at work (.476)	Loges94No17 – Figuring out what to buy (.572)
MD00No4 – My device helps me to see who I need to interact with on the job (.490)	Loges94No8 – Planning where to go for the evening and weekend activities (.557)
DBR89No10 – I use my device to provide information to my co-workers (.765)	
McD83 – Compared to other technologies, my device is my primary course of information in the workplace (.531)	

Table 2: Variable Means and Distributional Characteristics by Factor

Factor 1: "Information"	Mean/sd	Skewness/Kurtosis
I use my device to create information	5.00/1.992	-.658/-.843
I use my device to organize information	5.32/1.874	-.9823/.332
I use my device to analyze information	4.51/1.929	-.246/-1.056
I create information using my device	4.64/2.076	-.402/-1.192
My device helps me create information that is useful to me	5.01/2.005	-.693/-.774
I use my device to collect and organize information	5.16/1.917	-.794/-.518
I use my device to analyze and transform information I collect	4.00/2.060	.0278/-1.288
My device is useful for organizing and storing information I collect	5.04/1.970	-.812/-.517

Factor 2: "People"		
I use my device to communicate with others	6.85/.735	-6.343/44.999
My device puts me in touch with friends and family	6.51/1.269	-2.973/8.475
Other people depend on my device to stay in touch with me	6.04/1.569	-1.921/3.068
I use my device a lot	6.54/1.044	-1.836/3.156
My device is important to me	6.62/.989	-3.806/16.930
I rely on my device	6.36/1.199	-2.619/7.736
I use my device to provide information to my friends and family	5.78/1.536	-1.436/1.473

Factor 3: "Work"		
My device is the primary channel of communication in my workplace	3.63/2.129	.276/-1.302
My device is an important channel of communication in my workplace	5.07/2.131	-.728/-.899
My device controls my access to work-related information	3.35/2.110	.435/-1.149
My device facilitates my access to information that is important to me in my work	4.95/2.073	-.724/-.775
My device puts me in touch with co-workers who help me do my work	4.97/2.084	-.686/-.898
My device keeps me in touch with my supervisor	4.76/2/222	-.535/-1.169
My device keeps me in touch with employees who report to me	4.02/2.321	-.026/-1.497
My device helps me to learn what I have to do at work	3.42/2.113	.332/-1.250
My device helps me to see who I need to interact with on the job	3.09/2.141	.578/-1.115
I use my device to provide information to my co-workers	4.63/2.106	-.419/-1.216
Compared to other technologies, my device is my primary course of information in the workplace	5.78/1.536	.662/-.865

Factor 4: "Fun"		
Having fun with family and friends	4.94/2.060	-.746/.-711
Giving me something to do with my friends	4.41/2.162	-.264/-1.345
Participating in events I really enjoy without having to be there	3.56/2.148	.337/-1.259
Unwinding after a hard day of work	3.89/2.257	.045/-1.479
Relaxing when I am by myself	4.32/2/230	-.345/-1.348
Having something to do when nobody else is around	5.10/2.104	-.910/-.547
Deciding where to go to obtain services such as health, financial or household	4.59/2.230	-.429/-1.308
Figuring out what to buy	4.65/2.085	-.543/-1.006
Planning where to go for the evening and weekend activities	4.91/2.126	-.770/-.662

Distributional Properties of Variables by Factor

While the factors of Information, Work and Fun each displayed normal distributional tendencies, in line with the guidance of Hair et al. (1995), the People factor displayed highly unusual distributional characteristics. The frequency distribution for the factor and its strongly loading items was both peaked and skewed, and when examining the visual plot of the responses in Appendix 2, it can be clearly seen that the respondents answered quite uniformly that the technology was highly important for their social purposes, to the exclusion of almost all other answers. This borders on "yea-saying," even though most researchers would expect to find social uses for mobile technology to be quite high. To the extent that this factor represents use of work technology to link with one's social network, its results should be interpreted with caution. However, since each of the other factors is quite a bit more functional in its characteristics as regards the workplace than the People factor, it is safe to assume that the factors outside of social connectivity reflect important work uses and gratifications of the associated 3G technology.

Affinity for the Device

Using an adaptation of the Affinity for the Computer scale (Stafford and Stafford 2001), we checked to see how users would respond to an inventory of items designed to assess a motivational state not unlike needful dependence. As shown in Table 3, below, an interesting picture related to the concept of device dependency emerges.

Table 3: Variable Means for Affinity

Variable	Mean/sd
Using my Mobile Device is one of the more important things I do each day	4.47/1.994
I would rather use my Mobile Device than do anything else	2.14/1.730
I could easily do without my Mobile Device for several days	2.95/2.035
I would feel lost without my Mobile Device	4.45/2.138
If my Mobile Device was not working, I would not miss it	2.38/1.852

While neutral on the point of using the mobile device being a driving purposes in each day, as per variable one in the Table, and notwithstanding the general sense that they would *not* rather use the 3G phone than anything else, the respondents are quite clear that they could not do without their handset, and that they would certainly miss it if it were gone. A picture emerges of technology users that are multiply connected, using both desktop and handset access for their information resources. It is very likely that some of the sentiment about the handset as an aspect of work life comes from the "short leash" anecdote that professional knowledge workers like to use to describe how hard it is to remove themselves from work, given the multiple and mobile sources of connectivity to communications from superiors and coworkers. Even so, the response to several of the Affinity questions seems to demonstrate the reality of the mobile device as a key component of the workplace, serving as adjunct, perhaps, to more powerful stationary systems, but providing an important component of connectivity in the busy and information rich environment that is the workplace of a major state research university, which is the context in which this group of knowledge workers resided.

Discussion

The exploratory analysis undertaken here was meant to adapt and clarify aspects of media dependency measures taken from the mass communications literature in order to identify and begin the process of assessing dimensionality of a related technology dependence theory, taken in the specific context of the dependence upon mobile 3G devices in the workplace. A substantial number of media dependency items, even after adapting wording to the context of technology use, were filtered out in multivariate analysis, leaving a core group of items that corresponded to broad factors of Information Dependence, People Dependence, Work Dependence and recreational dependence. While several of these dimensions correspond with the core media dependency dimensions of recreational and social uses, as expressed by Ball-Rokeach (e.g., Grant et al. 1991) and applied in an Internet use context by Patwardham and Yang (2003), the dimensions we derive here are conceptually distinct, arising as they do from different sets of variables than the original recreation and playfulness dimensions of media dependence. It was our expectation entering the study that work-related technology dependency would not map directly to the play and social orientation constructs of the original 3-dimeision 18-item Ball-Rokeach inventory. It seems, however, that we must qualify this expectation; people and play also emerge as dimensions of dependence in our exploratory analysis, in addition to more pragmatic considerations of information and work, and it probably is the case that IT use, as with media use, is an extension even in the workplace of the social milieu of the user and will occasionally be tasked to personal and gratifying uses aside from work. That the Internet and its adjuncts are inherently more social than any other mass media technology has been known for some time (e.g., Kraut et al. 1998; Stafford et al. 2004). Anecdotes concerning Web surfing at work, and recently emerging concerns about the distracting aspects of social networking technologies in work environments are instructive in this regard (Skeels and Grudin 2009).

However, for that reason, specifically, the results of this exploratory study are quite valuable, as they begin the process of developing operational measures for assessing Technology Dependence in the workplace. The dimensions identified here through the exploratory factor analysis are candidate scales for future research in larger samples and differing workplace contexts, as an emerging Technology Dependency Theory is more fully explicated.

Managers will be guided in their deployment and allocation of technological resources by knowledge gained from the dependency relations identified her for initial consideration, and future research can lend additional insights to the notion that the dependence upon mobile devices for information access, use and sharing is a critical workplace dependency potentially linked with important job-related productivity variables. A key aspect of further investigation will be the explication of the 3G mobile device as a likely adjunct to main IT systems in the firm, and the expansion of concepts demonstrated here for assessing technology dependence could well benefit from re-application and investigation of a wider range of technologies than the humble mobile handset. The handsets that working professionals have access to are more powerful than the computers may of us had in our early careers, but they pale in comparison to the technologies that reside on the modern business desktop. These systems will also need to be investigated through the lens of technology dependence in the process of expanding our emerging understanding of the important concept of IS Continuance.

Notwithstanding that point, our interest in the concept of technology dependence was piqued by the massive discomfort and confusion that followed the recent unexpected failure of the RIM BlackBerry network. This prominent even served to remind users and researchers, alike, that there is more to the simple mobile phone than meets the eye, and it would be well to begin the process of understanding its increasingly dependent role in the technologically-enabled office of the knowledge markets of the present day.

Conclusion

This paper begins the process of explicating Technology Dependency in a managerially-relevant context as an aspect of IS Continuance, and it provides a starting point for developing, validating and utilizing operational measures of the theoretical construct toward more effective workplace performance and productivity. This study has surveyed the domain of mobile information technology dependency, and established basic dimensionality which can serve to guide emerging research on the use of and reliance upon technologies. Future research can take the steps of confirming the factors found here in broader contests.

It is clear that the mass communication concept of media dependency relations is adaptable to contexts in which Information and Communication Technologies are an integral part of the workplace routine, and the degree to which users come to satisfy work-related needs with such technologies will certainly give rise to analogous dependency relations that will be important to study, understand and manage.

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APPENDIX 1

Survey Instrument

	Factor Loading			
Scale Item	1	2	3	4
(Based on Ball-Rokeach 1985; 7-point Agree/Disagree format)				
BR85No1 - I use my Mobile Device to create information.	**.781**	.066	.250	.004
BR85No2 - I use my Mobile Device to gather information	.521	.585	.020	.142
BR85No3 - I use my Mobile Device to organize information	**.678**	.270	.060	.034
BR85No4 - I use my Mobile Device to analyze information	**.580**	.191	.095	.116
BR85No5 - I use my Mobile Device to share information with others	.334	.355	.165	.049
BR85No6 - I use my Mobile Device to communicate with others	.072	**.668**	.139	.047
BR85No7 - I use my Mobile Device to publicize events and causes I am personally concerned with	.438	.112	.155	.086
BR85No8 - My Mobile Device is the primary channel of communication in the workplace	.096	.126	**.576**	.004
BR85No9 - My Mobile Device is an important channel of communication in my work	.025	.133	**.843**	-.012
BR85No10 - My Mobile Device controls my access to work-related information	.257	.019	**.546**	.039
BR85No11 - My Mobile Device facilitates my access to information that is important to me and my work	.188	.168	**.708**	-.039
BR85No12 - My Mobile Device puts me in touch with co-workers who help me do my work	.098	.202	**.841**	-.052
BR85No13- My Mobile Device puts me in touch with friends and family	.149	**.722**	.077	.159
BR85No14 - My Mobile Device keeps me in touch with my supervisor	.311	.217	**.662**	.117
BR85No15 - My Mobile Device keeps me in touch with the employees who report to me	.184	.109	**.730**	-.148
BR85No16 - Other people depend on my Mobile Device to stay in touch with me	.264	**.587**	.189	-.071
(Based on Moy et al. 2005; 7-point Agree/Disagree format				
Moy05No1 - I rely on my Mobile Device for information	.391	.542	.126	.279
Moy05No2 - I use my Mobile Device a lot	.168	**.636**	.214	.150
Moy05No3 - My Mobile Device is important to me	.178	**.687**	.222	.237
Moy05No4 - I need my Mobile Device	.058	.336	.186	.069
Moy05No5 - I rely upon my Mobile Device	.199	**.559**	.154	.160
Moy05No6 - My Mobile Device is important for the purposes of accessing information	.377	.489	.165	.126
Moy05No7 - I rely on my Mobile Device for gaining access to information	.443	.493	.171	.253
Moy05No8 - I need my Mobile Device to gain access to information.	.190	.117	.126	.103
Moy05No9 - I focus on my Mobile Device when I use it	.171	.335	.075	.078
Moy05No10 - My Mobile Device takes a lot of my attention during the day	.170	.184	.108	.210
Moy05No11 - I generally pay attention to my Mobile Device when it signals me	.172	.485	.044	.160
(Based on Miller and Reese 1982; 7-point Agree/Disagree format)				
MR82No1 - I use my Mobile Device a lot	.260	.361	.117	.207
MR82No2 - I frequently use my Mobile Device	.099	.283	.107	.187
MR82No3 - I use my Mobile Device often.	.194	-.040	.289	.051
(Based on Morton and Duck 2000; 7-point Agree/Disagree format)				
MD00No1 - My Mobile Device is helpful in helping me to understand my position in the organization	.194	-.040	.289	.051
MD00No2 - My Mobile Device is helpful in helping me to understand my relations with others in my life	.024	.116	-.022	.240
MD00No3 - My Mobile Device is helpful in helping me learn what I have to do at work	.117	-.022	**.476**	.014
MD00No4 - My Mobile Device is helpful in helping me to see who I need to interact with on the job.	.196	-.046	**.490**	.026
MD00No5 - My Mobile Device is helpful in helping me learn what I have to do at home	.126	.101	.092	.221
MD00No6 - My Mobile Device helps me to see who I need to interact with in my personal life.	.033	.242	-.024	.264
(Based on DeFleur and Ball-Rokeach 1989; 7-point Agree/Disagree format)				
DBR89No1 - My Mobile Device helps me gather information	.560	.449	.146	.292
DBR89No2 – I use my Mobile Device to collect information	.649	.465	.175	.240
DBR89No3 - I create information using my Mobile Device	**.806**	.063	.257	.060
DBR89No4 - My Mobile Device helps me create information useful to me	**.749**	.155	.267	.130
DBR89No5 - I use my Mobile Device to collect and organize information	**.748**	.279	.101	.180
DBR89No6 - I use my Mobile Device to analyze and transform information I collect	**.684**	.045	.205	.168
DBR89No7 - My Mobile Device is useful for obtaining information	.558	.457	.125	.255
DBR89No8 - My Mobile Device is useful for organizing and storing information I collect	**.703**	.151	.150	.228
DBR89No9 - I use my Mobile Device to share information with others	.414	.295	.269	.218
DBR89No10 - I use my Mobile Device to provide information to my co-workers	.288	.033	**.765**	.014
DBR89No11 - I use my Mobile Device to provide information to my friends and family	.298	**.448**	.160	.329
DBR89No12 - My Mobile Device is helpful for transmitting information to others	.276	.382	.260	.285
DBR89No13 - My Mobile Device is helpful for sharing information	.290	.390	.202	.296

(Based on McDonald 1983; 7-point Agree/Disagree format)

McD83 - Compared to other technologies, my Mobile Device is my primary source of information in the workplace	.250	.048	**.531**	.046

(Based on Moy et al., 2005; ranking from most to least important)

Rank the following from most important (1) to least important (3) for purposes of accessing and communicating information in the workplace

____Internet Browser Webmail application	N/A	N/A	N/A	N/A
____Microsoft Outlook Desktop Client	N/A	N/A	N/A	N/A
____Mobile Device	N/A	N/A	N/A	N/A

(Based on Loges 1994; 7-point Agree/Disagree format)

Loges94No1 - Staying on top of what is happening in your community	.234	.243	.127	.168
Loges94No2 -Finding out how the country is doing	.190	.130	.040	.144
Loges94No3 -Keeping up with world events.	.184	.137	.017	.177
Loges94No4 -Gaining insight into why I do some of the things I do	.240	-.001	.137	.220
Loges94No5 -Imagining what it will be like as I grow older	.113	.030	.127	.256
Loges94N06 -Observing how others cope with problems or situations like my own	.182	.033	.125	.237
Loges94No8 -Giving my something to do with my friends	.009	.228	-.038	**.597**
Loges94No9 -Participating in events I really enjoy without having to be there	.024	-.003	-.038	**.534**
Loges94No10 -Unwinding after a hard day or week	.149	.052	-.135	**.770**
Loges94No11 -Relaxing when I am by myself	.159	.076	-.083	**.831**
Loges94No12 -Having something to do when nobody else is around	.183	.231	.037	**.789**
Loges94No13 -Discovering better ways to communicate with others	.254	.260	.033	.361
Loges94No14 -Thinking about how to act with friends, relatives, or people I work with	.168	.094	.005	.330
Loges94No15 -Getting ideas about how to approach others in important or difficult situations	.199	.074	.120	.379
Loges94No16 -Deciding where to go for services such as health, financial or household	.196	.183	.144	**.514**
Loges94No17 -Figuring out what to buy	.167	.156	.049	**.572**
Loges94No18 -Planning where to go for the evening and weekend activities	.208	.281	.037	**.557**

(Based on Stafford & Stafford, 2002; 7-point Agree/Disagree format)

SS01No1 - Using my Mobile Device is one of the more important things I do each day	N/A	N/A	N/A	N/A
SS01No2 - I would rather use my Mobile Device than do anything else	N/A	N/A	N/A	N/A
SS01No3 - I could easily do without my Mobile Device for several days (Reverse)	N/A	N/A	N/A	N/A
SS01No4 - I would feel lost without my Mobile Device	N/A	N/A	N/A	N/A
SS01No5 - If my Mobile Device was not working, I would not miss it (Reverse)	N/A	N/A	N/A	N/A

APPENDIX 2

Distributional Properties of People Factor

I use my Mobile Device to communicate with others.

My Mobile Device puts me in touch with friends and family.

Other people depend on my Mobile Device to stay in touch with me.

I use my Mobile Device a lot.

My Mobile Device is important to me.

I rely on my Mobile Device.

I use my Mobile Device to provide information to my friends and family.