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The Level Paradox of E-Collaboration:
Dangers and Solutions

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ABSTRACT

Although e-collaboration phenomena are multilevel in nature, research to date has been conducted from an exclusively single-level focus. This has lead to the level paradox. The dangers of the level paradox are discussed, including the potential that apparent cumulative knowledge may actually be spurious. Solutions to the level paradox are proposed in the form of future opportunities of research from several mixed-level approaches, and the benefits and barriers to mixed-level research are discussed. The article ends with a discussion on the necessity of finding a balance between single-level and mixed-level research, as well as on the necessity of single-level studies explicitly specifying the levels of theory, measurement, and data in their research.

Keywords: *Analysis, Bias, Communication Media, Cumulative Knowledge, Mixed-Level, Multilevel, Single-Level, Virtual Team*

INTRODUCTION

In the foundational issue of the International Journal of e-Collaboration (IJeC), founder and editor-in-chief Ned Kock provided the following operational definition of e-collaboration: "collaboration using electronic technologies among different individuals to accomplish a common task" (Kock, 2005b, p. i). Such a broad definition of e-collaboration entails a basic insight into the nature of collaboration that has been for the most part ignored: its multilevel nature. Within this definition we have different concepts that work together in a hierarchical system: the electronic technologies, different individuals, different environments, and a common task. Each of these elements is attached to a different hierarchical level and all together defines what e-collaboration is.

Such a hierarchy implies that e-collaboration includes phenomena at different levels and that the relation between higher and lower levels of the hierarchy should be theoretically specified and empirically examined. Despite this, we find that the vast majority of research in e-collaboration, especially quantitative research, entails single-level models; that is, models that specify relationships among constructs at one level of theory and analysis (Klein & Kozlowski, 2000).

The purpose of this essay is to draw attention to this level paradox of e-collaboration research. In doing so, the intention is not to criticize single-level research, as single-level

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research has been an essential tool for establishing the legitimacy our field. What is worrisome, though, is the *almost exclusive focus* on single-level research. Such exclusive focus can lead to an incomplete view of the phenomenon of interest (Goodman, 2000) and an impression of cumulative knowledge that might be spurious. Thus, this article hopes to spark some debate and add an additional voice to those of other researchers who have drawn attention to issues of level in e-collaboration research (e.g., Gallivan & Benbunan-Fich, 2005; Walczuch & Watson, 2001).

The above definition of e-collaboration also shows that the e-collaboration field spans multiple disciplines, from technical issues to social aspects. As a result, I would like to point out that when I refer to 'our field' I mean the e-collaboration research that has been done from a social science perspective, including virtual team and communication media choice research, thus excluding technical research on e-collaboration technologies.

This article is organized as follows. First, I explain the level paradox of e-collaboration by describing the multilevel nature of e-collaboration phenomena and the almost exclusive focus on single-level research. Second, I outline the potential dangers of the level paradox for the e-collaboration field. Third, I propose some solutions to the e-collaboration paradox, identify opportunities for research, and explain the barriers and benefits of the proposed solutions. Finally, I end the article with a discussion of the appropriateness of single-level and mixed-level research as well as acknowledge the limitations of this article. The hope is that this paper will give researchers in our field ideas to contribute to a deeper understanding of e-collaboration, its antecedents, its consequences, as well as the different elements that constitute it.

THE LEVEL PARADOX IN E-COLLABORATION RESEARCH

The *level paradox* points to the mismatch between the multilevel nature of e-collaboration phenomena and the fact that most research on it is single-level. Before exposing this contradiction, it is important to define the terms that are going to guide the discussion. When we build theories we should specify which entities need to be considered and are involved in the explanation of the phenomenon of interest (Whetten, 1989). Such entities to which research wishes to generalize are the focal units or level of theory (Hitt, Beamish, Jackson, & Mathieu, 2007; Rousseau, 1985). According to Rousseau (1985), two types of levels exist for research on a focal unit: the level of measurement and the level of analysis. The level of measurement represents the unit to which the data are directly attached (Hitt et al., 2007; Rousseau, 1985). In contrast, the level of analysis "is the unit to which the data are assigned for hypothesis testing and statistical analysis" (Rousseau, 1985, p. 4).

E-Collaboration is Intrinsically a Multilevel Phenomenon

According to Kock (2005b), e-collaboration has six main conceptual elements: the collaborative task, the e-collaboration technology, the individuals involved in the collaborative task, the mental schemas possessed by the individuals, and the physical and social environments surrounding the individuals. All these elements take place at different levels. For example, mental schemas belong to the individual level, while the collaborative task belongs to the group level. The other elements of e-collaboration also have important multilevel connotations. The physical and social surroundings of the e-collaboration phenomenon might be the same for some members in a collaborative task but not for others, creating an intermediate level between the collaborative task (at the group level) and the individuals engaged in it (individual level).

A key theoretical concept surrounding all these e-collaboration elements is the concept of technology use (Kock, 2005a). It has been shown how such use of technology belongs to multiple levels and represents a multilevel concept (Burton-Jones & Gallivan, 2007). The most common levels of technology use are the individual, the group, and the organiza-

tion (Burton-Jones & Gallivan, 2007). At the organization level, use can be conceptualized as an intra-organizational behavior (e.g., Masetti & Zmud, 1996). At the group level, use can be conceptualized as an aggregation of the individuals' behaviors belonging to the group (e.g., Easley, Devaraj, & Crant, 2003). And, at the individual level, use might represent an individual behavior (e.g., Davis, Bagozzi, & Warshaw, 1989). Use, however, can also belong to further levels such as that of the less intuitive experience level. The experience level (e.g., Rodell & Judge, 2009) is a level nested within individuals. Activities such as an employee browsing several websites, searching for specific information, and/or completing a web form, all belong to the experience level because they represent specific experiences occurring within individuals. The examination of such activities can tell us important information about how and why individuals modify their behaviors with specific technologies as well as how individual patterns of use and mental schemas are formed.

Past papers awarded best article status at IJeC also point to the multilevel nature of e-collaboration. Information warfare threatening commercial and government computing systems (Baskerville, 2006), the different effects of technology within and across individuals and groups (Markus, 2005), the effectiveness of deceptive communication in e-collaboration environments (Boyle, Kacmanr, & George, 2008), gender based cultural patterns through the use of information technology and communications (Gefen, Geri, & Paravatsu, 2007), the impacts of e-collaboration interactions and information capability on firm performance (Ko, Olfman, & Choi, 2009; Kristensen & Kijl, 2010), all point to the fact that e-collaboration is intrinsically multilevel.

In summary, the theoretical underpinnings of an e-collaboration episode, the data collected to examine it, and the analysis conducted in order to evaluate such data, have a hierarchical structure. The experiences with technology (experience level), the characteristics of individuals (individual level), and the dynamics and characteristics of each collaborating group (group level) belonging to one or more organizations (organizational level) in the same or different societies (country level) have multilevel connotations that need to be taken into consideration theoretically and empirically for the advancement of e-collaboration research.

The Single-Level Tradition of E-Collaboration Research

Apart from a few notable exceptions (e.g., de Leede, Kraan, den Hengst, & van Hooff, 2008; Short, Piccolo, Powell, & Ives, 2005), the overwhelming majority of research on e-collaboration is single-level. An informal search within IJeC with the words "multi-level" or "multilevel" renders no results. When this search is extended to databases such ABI/INFORM, similar results are obtained with the exception for the aforementioned studies. Thus, when one reviews the literature on e-collaboration at large, one finds that most of the published articles are single-level (Gallivan & Benbunan-Fich, 2005); that is, papers specify theory at a single-level, they collect data at a single-level, and they conduct analyses at a single-level. Furthermore, as Gallivan and Benbunan-Fich (2005) show, many of these papers, as explained later, have important inconsistencies between the levels of theory, measurement, and analysis that provide threats to the validity of their results.

Equally worrisome is that extensive and comprehensive literature reviews on e-collaboration, such as those conducted on virtual teams, lack discussions about the level of theory, measurement, and analysis of the reviewed papers when synthesising such research (e.g., Martins, 2004; Powell, Piccoli, & Ives, 2004; Webster & Staples, 2006). As a result, we could be discussing the effects of virtuality on communication effectiveness and overlook whether such effects generalize at the individual (e.g., Chidambaram & Jones, 1993) or group (e.g., Benbunan-Fich, Hiltz, & Turoff, 2002) levels and/or whether the studies manifested inconsistencies between the level of theory, analysis, and data (e.g., Burke & Chidambaram, 1999).

Consistent with this is the fact that quantitative reviews (meta-analysis) of research on virtual teams have discovered important differences in results when the same relations are examined at the individual or group levels (Ortiz de Guinea, Webster, & Staples, 2005).

Summary

An overwhelming majority of studies of e-collaboration, although studying a multilevel phenomenon, are conducted theoretically and empirically at a single-level. This mismatch between the multilevel structure of the actual phenomenon under study and the single-level ways in which research is theoretically specified and empirically conducted represents a paradox. Such a level paradox has important consequences for our field.

THE DANGERS OF THE LEVEL PARADOX

Studying a multilevel phenomenon from a single-level perspective is worrisome. It can lead to an understanding of the subject under study that may suffer from several fallacies. Such fallacies can be responsible for some of the inconsistent results in our field and can threaten the validity of what we think we know about e-collaboration (Gallivan & Benbunan-Fich, 2005). By overlooking this single-level focus, we may be making erroneous inferences from research that is not comparable (e.g., individual and group levels).

These potential misleading inferences can be classified under the grand umbrella of ecological and atomistic fallacies. An ecological fallacy involves making inferences from aggregated data to a lower level of analysis (Rousseau, 1985). An atomistic fallacy is the opposite: drawing inferences from lower level information to higher level units (Luke, 2004). I will examine each of these fallacies in their most prevalent and specific forms to better illustrate the numerous ways in which they can develop.

Issues Associated with Misalignments Between Levels of Theory, Analysis, and Measurement

A recent review of the empirical literature on e-collaboration shows two thirds of single-level papers (published between 1999 and 2004 in six leading IS journals) have inconsistencies with respect to the level at which theory is specified, the level at which data are collected, and the level at which analyses are conducted (Gallivan & Benbunan-Fich, 2005). Such inconsistencies raise serious questions about the validity of such studies (Gallivan & Benbunan-Fich, 2005).

The first set of problematic studies represent articles in which the focal unit was the group; the data were collected at the individual level and aggregated to the group level without appropriately conducting analyses justifying such aggregation. The aggregation or the combination of data at one level to a higher level (Klein, Danserau, & Hall, 1994; Rousseau, 1985) must be justified by showing that there is enough homogeneity within the higher level unit to which the data is to be aggregated (James, 1982; Klein et al., 2000). If this is not done, as was the case with the studies identified by Gallivan and Benfunan-Fich (2005), there is a threat to the validity of results because of the potential for aggregation bias. The results of such studies might not be valid to the extent that they can be "an artifact of the data combination method" (Rousseau, 1985, p. 6). For example, Limayem and DeSanctis (2000), when studying some constructs at the group level (such as decision confidence) aggregated data based on individual-level responses without conducting statistical tests of within-group homogeneity in order to justify the aggregation of data to the group-level.

A second set of problematic studies identified by Gallivan and Benbunan-Fich (2005) represented articles in which the focal unit was the group but the level of measurement and analysis was the individual. Such studies fail

in what is known as misspecification or the fallacy of the wrong level (Rousseau, 1985). The fallacy of the wrong level occurs when we use, for example, individual-level data and analysis to make theoretical inferences about the group level (Rousseau, 1985). For example, Burke and Chidambaram (1999) specified relations at the group level in the hypotheses, such as different perceptions of communication interface between groups using different media; however, when reading their results, it appears that the analyses on such perceptions were carried out at the individual-level.

Even if the level of analysis and the level of theory are congruent and the aggregation of data to higher levels is justified, there might still be some potential issues. Some authorities in multilevel research have argued that it is the level at which data are analyzed that needs to be congruent with the level of theory and, thus, that the level of data does not need to match the level of theory and analysis (Klein et al., 1994). Accordingly, many ways in which to aggregate individual level data to the group level have been proposed (e.g., Klein et al., 2000; Walczuch & Watson, 2001). However, others have argued that such aggregation of data to the group level to perform analyses has the potential for meaningful individual level variance to be ignored (Hofmann, 1997). These authors explain that if you have individuals working on groups, and you collect data at the individual level, the data should be tested using multilevel approaches rather than aggregating data to the group level; otherwise, there is always variance on the variables of interest within groups that can be meaningful but is ignored (Hofmann, 1997).

Other Issues Associated With Single-Level Research on Multilevel Phenomena

The potential for problematic issues is also high even when we do not have a mismatch between levels of theory, analysis, and data. Potential issues might exist when the theory, data, and analysis are conducted at the individual level but the individuals work in groups (Gallivan & Benbunan-Fich, 2005). For example, when we study the individual learning outcomes of two different distributed environments of individuals working in groups (e.g., Alavi, Marakas, & Yoo, 2002), we need to account for the fact that those individuals are not independent of each other. That is, when we fail to account for the dependencies of those individuals within their groups, the independence of the observations assumption when conducting statistical analysis techniques is violated (Bryk & Raudenbush, 1992; Hofmann, 1997)[1].

Related to this are contextual fallacies. Contextual fallacies occur when we fail to include the potential effects that higher-level factors can have in a relationship between two constructs at a lower level (Rousseau, 1985). If such factors are ignored, the relationship between the two constructs at the lower level might be spurious (Rousseau, 1985). For example, some research on e-collaboration at the individual level has shown that individuals communicating in more virtual ways participate more in their group tasks (Valacich, Sarker, Pratt, & Groomer, 2002). In contrast, other research has found a negative relation between virtuality and participation (Mathieu, 2007). In this case, properties at the group level could be playing a role in moderating the relation between virtualness and participation. For example, a positive relation between virtualness and participation might only hold if certain group norms are in place (e.g., communication anonymity). Such a contextual fallacy points to the fact that when we conduct e-collaboration research, we might be falling in what has been characterized as errors of exclusion (Benbasat & Zmud, 2003), or the failure of including important core properties of e-collaboration in our research models.

Cross-level fallacies can take place when the "same construct is used to characterize phenomena at different levels" (Rousseau, 1985, p. 8). Cross-level fallacies occur when we use constructs in the same content domain but that operate at different levels (Chan, 1998). For example, in e-collaboration we often talk about individual perceived conflict (e.g., Wakefield, Leidner, & Garrison, 2008) and group conflict

(e.g., Hobman, Bordia, Irmer, & Chang, 2002). When doing so, we often fail to specify whether these two constructs at different levels mean the same thing across the two levels or are only weakly related to each other (Rousseau, 1985). That is, we need to state how the two constructs relate across levels (Rousseau, 1985) and failure to do so increases the likelihood of making erroneous inferences from one level to a higher or lower unit. Of special interest is the potential for 'anthropomorphizing' collective activities (Rousseau, 1985). This occurs, for example, if we attribute personality traits, such as extraversion, to the group (e.g., Balthazard, Potter, & Warren, 2002) without specifying how individual extraversion relates to group extraversion or how group extraversion emerges. As a result, we might end with a list of construct names spanning multiple levels that offer little insight into their true meaning (Chan, 1998).

Summary

The level paradox raises some important concerns about research on e-collaboration to date. It might be at the heart of the abundant inconsistent results found in our field (Gallivan & Benbunan-Fich, 2005). It also yields concerns about the validity of some of our research (Gallivan & Benbunan-Fich, 2005). Perhaps most importantly, the level paradox might be offering us a spurious impression of cumulated knowledge based on research that is not comparable to each other. An exclusive focus on single-level research might lead to errors of exclusion and, thus, leave some important core properties of e-collaboration unexplored.

POTENTIAL SOLUTIONS TO THE LEVEL PARADOX

Mixed-level research on e-collaboration can address some of the concerns exposed previously. This idea has been summarized in the words of Luke (2004, p. 7): "Because so much of what we study is multilevel in nature, we should use theories and analytic techniques that are also multilevel". This section explores some mixed-level opportunities for future research on e-collaboration, including composition models, cross-level models, and multilevel models. A summary of these models and opportunities for future research is provided in Figure 1.

COMPOSITION MODELS

Compositional models represent an opportunity to start differentiating between constructs at different levels. They specify the "the functional relationships between variables at different levels presumed to be functionally similar" (Rousseau, 1985, pp. 11-12). That is, a composition model specifies "the functional relationships among phenomena or constructs at different levels of analysis (e.g., individual level, team level, organizational level) that reference essentially the same content" but may be qualitatively similar or different at different levels (Chan, 1998, p. 234). Compositional models specify whether constructs at different levels are parallel, identical or weakly related (Hitt et al., 2007; Rousseau, 1985).

A compositional model can be characterized by a functional relation of isomorphism or the fact that constructs mean the same thing across levels (Rousseau, 1985). Other research, although not directly building isomorphic models, provides insights onto the nature of isomorphism (e.g., Klein, Tosi, & Cannella, 1999; Morgeson & Hofmann, 1999) and the different types of group level constructs that might arise (e.g., Klein & Kozlowski, 2000). Apart from isomorphism, various other composition models exist. Chan (1998) has proposed several compositional models based on different functional relationships between constructs at different levels. The most employed when aggregating data to the group level from individual level information have been the additive and direct consensus models (Chan, 1998). The additive model states that the higher level unit construct is a summation or average of the lower level units' scores (Chan, 1998). In contrast, the direct consensus model state that the meaning of the

Figure 1. Summary of opportunities for mixed-level research on e-collaboration

Mixed-Level Models		Characteristics	Summarized Form[1]	Examples of Possible Research Questions on E-Collaboration
Composition models		Specify the functional relation between constructs at different levels that tap into the same content but might be qualitatively similar, strongly or weakly related.	.... ↑ $X_{level-3}$ ↑ $X_{level-2}$ ↑ $X_{level-1}$	In communication media choice: what is the relation between individual-level perceived social norms, and actual explicit social norms at the group (and/or organizational) levels? In virtual teams: what is the relation between patterns of individual technology use and patterns of group technology use?
Cross-level	Direct effects models	Specify the influence of a variable at one level on a variable at a different level	$X_{level-2}$ → $Y_{level-1}$	In communication media choice: What is the influence of different social factors (e.g., social influence) on individual-level media choice? In virtual team: what is the relation between group-level climate on individuals' commitment to the group?
	Moderator models	Specify the interaction of two variables at a different level in predicting a variable at a lower (or higher) level	$X_{level-2}$ ↓ $Z_{level-1}$ → $Y_{level-1}$	In communication media choice: How do different social factors influence the relation between individual-level perceived media richness and individual-level media use? In virtual teams: how does group climate influence the relation between individual-personality and individual performance?

Mixed-Level Models		Characteristics	Summarized Form[1]	Examples of Possible Research Questions on E-Collaboration
Cross-level	Frog-pond models	Specify the influence of the relative standing of a lower level unit within a higher level unit on a variable at the lower level	$(X_{L1}-\bar{X}_{L2}) \rightarrow Y_{L1}$	In communication media choice: what is the relation between a person status on a group and his/her choice of media use when treating delicate issues? In virtual teams: what is the relation between an individuals' relative performance in a group on his/her self-efficacy beliefs?
	Mediational models	Specify the interaction of two variables at a different level in predicting a variable at a lower (or higher) level	$Z_{level-2}$ ↗ $X_{level-1}$ ↘ $Y_{level-1}$	In communication media choice: do social factors mediate the relation between individuals' perceived richness of media and media use? In virtual teams: does group conflict mediate the relation between individuals' attitudes to the group and their commitment to the group?
Multilevel (or homologous) models		Specify relations among independent and dependent variables that are generalizable across levels	$X_{level-3} \rightarrow Y_{level-3}$ $X_{level-2} \rightarrow Y_{level-2}$ $X_{level-1} \rightarrow Y_{level-1}$	In communication media choice: Does the relation between perceived media richness and media choice holds across individuals and groups? In virtual teams: does the relation between perceived task conflict and performance holds across individuals and groups?
Note: The above models can also be combined to examine more complex research questions				

higher level construct is the consensus among the lower-level units in the subject matter under consideration (Chan, 1998).

Other less intuitive models exist that are characterized by compilation or the fact that the higher level construct reflects a complex nonlinear combination of a lower level property (Kozlowski & Klein, 2000). For example, the dispersion model specifies that the meaning of the higher-level construct resides in the dispersion or variance among lower-level units (Chan, 1998). Such a dispersion model characterizes the functional relation between psychological climate (individual level) and climate strength (group level) (Chan, 1998).

Composition models provide trustworthy research for two main reasons: they provide a strong theoretical argument for justifying different forms of aggregation (Chan, 1998; Rousseau, 1985) and, perhaps most importantly, they increase the validity of the constructs under study (Chan, 1998). As a result, many opportunities for research exist in specifying how constructs at the individual level (e.g., individual-level satisfaction) relate to those same constructs at the group level (e.g., group-level satisfaction). A notable example in virtual team research of such a theoretical specification between an individual-level construct and its group-level counterpart is given by Kirkman, Rosen, Tesluk, and Gibson (2004) in their elegant discussion of how group-level empowerment differs from individual-level empowerment.

CROSS-LEVEL MODELS

As the name indicates, cross-level models include those models that specify relations between variables at different levels (Klein & Kozlowski, 2000; Rousseau, 1985). The following section discusses the different types of cross-level models that can be applied to e-collaboration research.

Cross-Level Direct Effects Models

The first types of cross-level models are those of direct effects. Direct effects models explore the influence of a variable at one level on another variable at a different level (Rousseau, 1985). The most common are those specifying the impact of a variable at one level on another variable at a lower-level (Klein & Kozlowski, 2000). Although such effects have been rarely explored in the Information Systems (IS) field, a domain in which some e-collaboration research is conducted, Cenfetelli and Schwarz (in press) show how different websites (higher-level) have significant effects on individuals' intentions to use those websites in the future (lower-level). More specifically, in the e-collaboration field we could study the effects of group climate on individuals' commitment to the group in virtualized contexts, or the effects that certain organizational and/or group norms might have on individuals' perceived self-efficacy beliefs. Furthermore, the literature on communication media has included social factors, such as social influence (e.g., Treviño & Stein, 2000; Webster & Treviño, 1995), that have been specified at the individual-level. As a result, future research could specify such social factors at a higher level and examine their influence on individual-level media choice.

Although less common, direct effects models can also specify the relations between a variable at a lower level to a variable at a higher level. This possibility appears to be critical for the advancement of knowledge in e-collaboration because such models can answer important research questions. For example, we could study the relationship between individual-level characteristics (e.g. experience, skills, personality traits, or self-efficacy with the task and the technology) and group-level performance (e.g., quality and productivity) in virtualized contexts. This aligns with recent calls for research on individuals' cognitions and emotions in virtual team research (Martins, 2004).

Cross-Level Moderator Models

The second group of cross-level models are moderator models. These models specify that a variable at one level moderates the relationship between two other variables at a lower level (Klein & Kozlowski, 2000; Rousseau, 1985). That is, these models state that two variables at different levels (e.g., group and individual) interact in predicting another variable at the lower level (e.g., individual) (Klein & Kozlowski, 2000). These models are characterized by what Firebaugh (1978) called comparative functions: the effect of a characteristic of a higher unit on the relationship between two variables at a lower unit. Moderator models have the potential to address the contextual fallacy concern explained in the previous section and prevent some of the errors of exclusion from which our research might suffer. Important gaps in our literature can be filled with these models: we could study potential moderators (e.g., group norms about communication) on the relation between the level of perceived virtualness and individual participation, we could see if group climate interacts with individual personality to predict individual performance within groups, we could also study how certain social processes (such as sponsorship) interact with individual-level attitudes in the choice of a specific communication media, as suggested by Markus (1994).

Although less common, cross-level moderator models might also include moderators at a lower level (e.g., individual) on the relation between two variables at a higher level (e.g., group) (Rousseau, 1985). In this case, we could study whether personality characteristics of individuals in the group interact with group cohesion when predicting group performance.

As a note of caution, it is important to stress that these models have been criticized for being empirically driven and thus lacking an appropriate theoretical base (Rousseau, 1985); however, this might not always be the case. One important part of theory construction is the specification of its boundaries (Bacharach, 1989; Bamberger, 2008). Situational, contextual, spatial, and temporal assumptions give us important insights by telling us under which circumstances a theory 'works' (Bacharach, 1989; Bamberger, 2008).

Cross-Level Frog-Pond Models

The third types of cross-level models are the frog-pond models. These uncommon models study normative functions (Firebaugh, 1980) or the relative standing of a lower level unit (e.g., individual) within a higher level one (e.g., group)[2] (Klein et al., 1994; Rousseau, 1985). The idea is that the relative standing of an individual in a group can play an important role in determining his/her behavior because, as Davis (1966, p. 21) explains, individuals "can choose to be big frogs in little ponds or little frogs in big ponds". Although such models are more often pursued in the sociological field, they open interesting opportunities for e-collaboration research. For example, an individual relative performance within an e-collaboration group can have important consequences for his/her self-efficacy beliefs. That is, an individual whose true performance is mediocre, might increase his self-efficacy beliefs when e-collaborating with others whose performance is even lower (Klein & Kozlowski, 2000). Likewise, an individual status position within a group can very well determine his/her leadership behavior in the group.

Cross-Level Meditational Models

Although cross-level mediational models, also called meso-mediational models, have been traditionally ignored when explaining cross-level models[3] (Klein & Kozlowski, 2000; Rousseau, 1985), they represent another possibility for cross-level research. Thus, cross-level models can take complex forms, including meditational relationships across different levels (MacKinnon, 2008; Mathieu, Maybard, Taylor, Gibson, & Ruddy, 2007; Mathieu & Taylor, 2007). These meso-meditational designs follow the same logic for specifying and testing mediational effects as single-level research (Baron & Kenny, 1996) but do so by proposing media-

tors that can traverse across levels (Mathieu & Taylor, 2007). Mediators play a key role in the advancement of theory and research because they clarify the process by which an antecedent influences the output of interest (Baron & Kenny, 1996; Mathieu & Taylor, 2007). When we include the possibility of characterizing such underlying processes across different levels, the potential for explanation is substantially enhanced. For example, management research has shown that individuals' role clarity mediates the relationship between group level leadership and individuals' self-efficacy (Chen & Bliese, 2002). Likewise, Seibert, Silbert, and Randolph (2004), after explaining that psychological empowerment (individual-level) is different than empowerment climate (group-level), show how psychological empowerment mediates the relation between empowerment climate and individual job satisfaction and performance. As a result, cross-level mediational models provide substantial opportunities for future research on e-collaboration which aligns with calls for research in the socio-emotional and task processes involved in mediating the relations between input and outputs in virtual teams (Martins, 2004; Powell et al., 2004).

MULTILEVEL MODELS

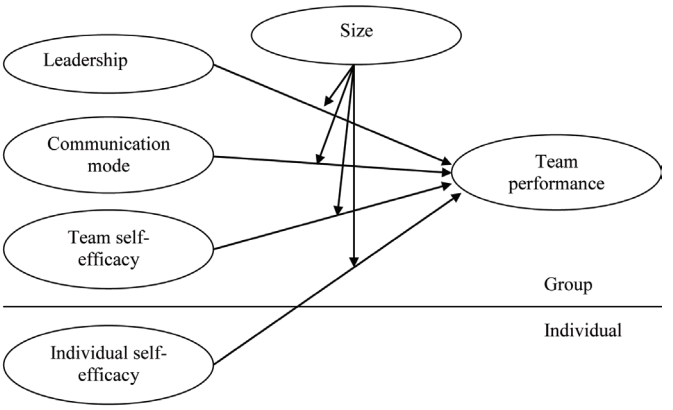
Multilevel models, also called homologous models, specify relations among independent and dependent variables that are generalizable across levels (Chen, Bliese, & Mathieu, 2005; Klein & Kozlowski, 2000; Rousseau, 1985). Such models specify that "a relationship between two variables holds at multiple levels of analysis" (Klein & Kozlowski, 2000, p. 219). An important requirement for drawing such models is that a composition model with such constructs at different levels needs to be specified beforehand because these models assume that constructs at different levels are equivalent (Rousseau, 1985). Before stating and arguing that a positive relation between self-efficacy and performance at both individual and group levels exist, such models need to specify that the self-efficacy and performance constructs are functionally similar across the two levels. Various statistical procedures for testing homologous models have been recently proposed (e.g., Chen et al., 2005). In this case, further research could study the processes by which both individuals and groups decide on which communication media to use and if those relations hold across levels.

The main advantage of these types of models is that they provide theories that are highly generalizable as well as provide integration between different levels (Klein & Kozlowski, 2000). However, such models risk over-simplifying the phenomena under study when finding constructs that are functionally similar across levels (Klein & Kozlowski, 2000). Such models hold two promises for the field of e-collaboration. First, they can specify which relationships are likely to hold across individual and group levels and, thus, provide explanations for the inconsistencies found between levels of analysis (Ortiz de Guinea et al., 2005). For example, such models could specify why the relation between knowledge sharing and performance in virtualized contexts is expected to hold (or not hold) across individual and group levels. Second, if these models are pursued the e-collaboration field might become an important reference discipline for other fields from which to generalize our theoretical insights and empirical findings.

SUMMARY

Mixed-level models represent a potential solution from which to start addressing the level paradox of e-collaboration research. Many mixed-level models exist, from composition models through different types of cross-level models to multilevel ones. Such models represent future opportunities for research on e-collaboration. Of course, these models can be combined with one another to provide more complex explanations of e-collaboration phenomena.

Figure 2. Example of a cross-level model for virtual team research



STEPS FOR MIXED-LEVEL RESEARCH ON E-COLLABORATION THROUGH AN EXAMPLE

To better illustrate how the above ideas can be put into practice, I will develop a very brief and simple example of a possible research project in virtual teams. Imagine we are interested in exploring the extent to which individual's self-efficacy, team's self-efficacy, communication mode (either face to face or electronic), and team leadership influence team performance and whether such relations are moderated by team size (Figure 2). Please note that I am not trying to develop a theoretical sound model; instead, the objective is to provide a *brief example with variables of different types and levels* in order to show the steps that mixed-level research should follow. The recommendations in the next section draw from examples provided by the multilevel literature (e.g., Klein & Kozlowski, 2000; Rousseau, 1985).

Theoretical Development and Construct Specification

With any cross-level research endeavors, we need to follow some steps during theoretical development. Our research model is a cross-level model with both direct and moderator effects and constructs at the individual and team levels. One of the most important steps in the theoretical development is to specify the composition (or compilation) models of how our high level constructs (e.g., team) come to be (Rousseau, 1985). Thus, the first challenge with such research will be to define each of the constructs at their focal unit. Before getting into the team-level constructs, we can define individual's self-efficacy based on past research at the individual level (e.g., Ortiz de Guinea & Webster, 2011).

Now, we turn to the team-level constructs. There are three basic types of team-level constructs: global team properties, shared team properties, and configural team properties (Klein & Kozlowski, 2000). Global team properties are characteristics of teams that are objective and easily observable (Klein & Kozlowski, 2000); such properties do not emerge from the characteristics of the individual team members but they exist apart from them (Klein & Kozlowski, 2000). For example, team size and team communication mode can be thought of as global team properties. Size is an objective characteristic of the team and we do not need to collect data from each individual team member in order to measure it. The same occurs with team communication mode if we are going to characterize it as either face to face or virtual (electronic communication).

Unlike global team properties, shared team properties emerge from individuals team members' attitudes, experience or beliefs (Klein & Kozlowski, 2000). Team self-efficacy and team leadership can be seen as shared team properties for various reasons (Klein & Kozlowski, 2000). Some literature on leadership suggests that team members are likely to have homogeneous perceptions about their leader (Danserau & Yammarino, 1998) because interaction among team members (e.g. discussion) is likely to make individuals' opinions about the leader more alike. Thus team leadership appears to follow the direct consensus composition model (Chan, 1998), explained earlier, where the meaning of team leadership stems from consensus among team members.

Team self-efficacy can also be conceptualized as a shared team property (Klein & Kozlowski, 2000). If we define team self-efficacy as stemming from individuals' self-efficacy belief then team self-efficacy will be characterized by a composition model in which the team self-efficacy variable should be a summation (or average) of individuals' self-efficacy. Our theory, however, might indicate that the team self-efficacy construct is different from a combination of individuals' self-efficacies: it may be that an individual has lower self-efficacy beliefs about himself but still strongly believes in the capabilities of his/her team (Klein et al., 2000). This would be characterized by a reference shift consensus model in which a change in meaning of the construct appears when the reference of such beliefs is shifted from the individual to the team (Chan, 1998). In this case, individuals should be explicitly asked about their team self-efficacy and then the consensus among them can be analyzed to justify the aggregation of individuals' responses about the team to the team level (Chan, 1998). One of the two possibilities for the team self-efficacy construct needs to then be chosen depending on the theory that is guiding our research.

The third type of team constructs are configural team properties. Like shared properties, configural team properties stem from team member's beliefs, attitudes, and behaviors (Klein & Kozlowski, 2000). However, unlike shared properties, configural properties capture the variability of individuals within a team (Klein & Kozlowski, 2000). It can be argued that team performance is a configural team property because it emerges from "the complex conglomeration of individual team members' performance" (Klein & Kozlowski, 2000, p. 217). Depending on the task or the dimension more important for our theory, team level performance might be concerned with the sum of individuals' performance or, instead, might reflect the best member's performance or the variability in performance among team members (Klein & Kozlowski, 2000), thus forming a compilation model. As a result, we should determine and explain which of these reflects team performance for our project while taking into consideration past literature and our theory.

The specification and definition of constructs at their focal unit will help in attaining acceptable construct validity. Furthermore, we should develop the logical arguments (or theory) that provide the justification for the predicted relations between constructs (Whetten, 1989). The process of developing our hypotheses is no different than that done in single-level research. The idea is to state "why" a relation between the constructs of interest exist in a coherent manner (Webster & Watson, 2002) given the theoretical definition of our constructs.

Research Design and Data Analyses

The research design is of paramount importance in establishing the adequate conditions for testing a research model. This requirement is exacerbated in cross-level research because we need to assure variability at different levels (Rousseau, 1985). In our example we need to assure that the sample has sufficient variability at the individual and team levels (Klein et al., 2000). In order to do this for any N individuals we need to maximize the number of teams (Rousseau, 1985). If the number of teams is small compared to the number of individuals, variability in team level variables will be small

and thus problematic for testing cross-level hypotheses (Rousseau, 1985). Ideally, measures of shared team properties, such as team self-efficacy, should show variability across teams but at the same time homogeneity within teams (Klein et al., 2000). In contrast, with respect to configural constructs such as team performance, data needs to vary from team to team as well as within teams: "one can only test the correlates of within-unit variability (a configural construct), for example, if units vary in their within-unit variability" (Klein et al., 2000, p. 221). In summary, to test our research model the ideal sample would be as follows: 1) performance varies between and within teams, 2) team self-efficacy and leadership vary between teams but not within teams, 3) individual self-efficacy varies across individuals, and iv) size and communication mode vary across teams (no variation within teams since they are global constructs).

In terms of data manipulation, it is indispensable to be able to match individuals' responses to the team to which they belong (Rousseau, 1985). Furthermore, if individual level perceptual data is going to be aggregated to the team level (such is the case with team self-efficacy or leadership) we would need to establish the level of agreement of team members in such perceptual measures (Rousseau, 1985). That is, we need to test if perceptions of leadership and team self-efficacy are in fact homogeneous within teams (Klein & Kozlowski, 2000). Numerous statistics, such as the intraclass correlation and the r_{wg} index, exist in order to do so (Klein et al., 2000; Klein & Kozlowski, 2000). The homogeneity of configural properties within units, such as team performance, should also be analyzed in order to see if, in fact, such constructs represent non-homogeneous properties.

In order to be able to perform analyses, the data should be maintained at the lowest level possible: for example, we should have a line (or a case) in our data file for each individual. The global, aggregated, and configural variables of each team should be repeated in the individual line for each individual in the team. This is generally how the data need to be organized in order to perform analyses (e.g., SPSS). Before performing analyses we need to check if data are missing at random and this is done in the same way as testing for missing data in single-level research (Tabachnick & Fidell, 2007). Some techniques for dealing with missing data that are not missing at random exist (Enders, in press; Muthén, Asparouhov, Hunter, & Leuchter, in press). Once we have checked for the occurrence of missing data, we can proceed with analyses. Analyses can be performed with different statistical procedures: SPSS, SAS, and HLM can be used to test direct as well as moderator cross-level effects models. Numerous examples of how to do these analyses exist and can be followed (e.g., Bickel, 2007; Otondo, Barnett, Kellermans, Pearson, & Pearson, 2009; Peugh & Enders, 2005). Finally, it is important to note that if complex models need to be tested using path analysis techniques then there is the possibility of employing MPlus or other structural equation modeling techniques such as LISREL.

An important implication worth mentioning is that mixed-level techniques for construct specification can inform single-level research, especially at the group or higher levels. The mixed-level literature on construct specification offers a good approach for the definition of constructs at higher levels and single-level research (e.g., research conducted at the group level) can benefit from such literature when theoretically developing concepts and models.

Summary

A simple and brief example of cross-level research in virtual teams is provided here in order to offer specific and practical steps for researchers when approaching cross-level research. During theoretical development, the constructs need to be defined and specified at their appropriate levels. Also, the theory needs to explain how such constructs emerge (e.g., global properties, shared properties, or configural properties). A justification of the hypothesized relations between constructs is also needed as it is done with single-level research. For research

design purposes, it is critical to draw samples for which the number of high level units is maximized. For some variables we might need variability within and across units while for other constructs we need homogeneity within units but variability across them. Techniques for assessing homogeneity and consensus within units exist as well as statistical packages that allow for multilevel regression techniques to be used to test the relations of interest.

BARRIERS AND BENEFITS OF MIXED-LEVEL RESEARCH ON E-COLLABORATION

Although mixed-level research on e-collaboration can be beneficial, there are some barriers to conducting mixed-level research on e-collaboration. Likewise, although some benefits of e-collaboration were outlined in the earlier sections, less intuitive benefits need to be discussed.

Barriers to Mixed-Level Research

A barrier to mixed-level research has been statistical packages (Bamberger, 2008). However, with the appearance of multiple statistical packages that include the possibility of multilevel modeling and mixed-level analyses (e.g., HML, SAS, SPSS, MPlus) that are well suited for answering different research questions, this appears to be less of a concern. A related issue is the traditional lack of training of researchers in mixed-level analytical techniques and multilevel development theory (Klein et al., 1999). Thus (micro and macro) researchers need to be open minded when studying a phenomenon and ready to look up or down to different levels in order to better study the e-collaboration phenomenon.

This point has an important consequence as well for the review process. The institutional pressures of our academic lives dictate that we need to 'publish or perish'. If we construct mixed-level theory and research, micro reviewers might not see the necessity of including higher-level elements and/or macro reviewers might not see the relevance of the lower-level components of our research (Klein et al., 1999). More importantly, our lack of training on multilevel research might trigger difficult reviews of mixed-level research with important consequences for our research careers.

Another barrier for mixed-level research is in determining the scope of such research (Klein et al., 1999). If e-collaboration is a phenomenon that occurs at the experience, individual, group, organizational, inter-organizational, and societal levels, then the volume of research and theory available and relevant to researchers is too vast and problems concerning the scope of the proposed theory and research might arise (Klein et al., 1999). If one decides to shift levels from relations and constructs at the individual level to the group, one might end up with a too simplistic view of the phenomenon under study. On the contrary, if one decides to study cross-level theories spanning different constructs and diverse levels, one might end up with very complex systems that compromise the parsimony of theory and research. As Klein et al. (1999, p. 244) put it "The appropriate middle ground – not too simple, yet not too complex – may be difficult to find".

Multilevel data are difficult to collect as well. If gathering samples for our single-level research is already a challenging task, having to do so from multiple individuals across multiple groups and organizations might be appalling (Klein et al., 1999), not to mention time consuming and expensive. Furthermore, the required sample size at each different level to yield powerful results is difficult to determine (Klein & Kozlowski, 2000). For example, if samples do not contain enough variability, our results might result in range restriction biases (Klein & Kozlowski, 2000).

Related to this is the fact that conducting mixed-level analyses is also a difficult task. Not only because of the lack of training but, more importantly, because the appropriate ways in which to conduct analyses of mixed-level data have been at the core of many debates (e.g., Klein et al., 2000; Kozlowski & Klein, 2000; Yammarino & Markham, 1992). These debates include discussions about appropriate ways to

specify multilevel theory, multilevel techniques for conducting analyses, and the combination methods for appropriately aggregating data from one level to the next. For example, ongoing debates exist on the ways in which construct validity of multilevel constructs can be tested (e.g., Chen, Mathieu, & Bliese, 2004; Hofmann & Jones, 2004). As a result these debates on the core properties of multilevel research leave a sense of confusion for the researcher willing to pursue mixed-level endeavors.

BENEFITS OF MIXED-LEVEL RESEARCH

Some benefits of mixed-level research can be drawn from earlier sections of this paper and do not need to be repeated. Others however, because less intuitive, warrant explicit attention. For example, the goal of e-collaboration research, as of any other scientific discipline, is to build a cumulative set of knowledge about the phenomena under inquiry (Keen, 1980). Single-level research in our field might have given a spurious sensation of cumulative knowledge resulting from reviewing articles that are not comparable or that include inconsistencies between levels of analysis, data, and theory. Thus mixed-level research approaches in e-collaboration can very much contribute to the research goal of cumulative knowledge by overcoming the limitations of single-level research. Although these approaches can generate complex theories and results, they can also provide much of the clarification, synthesis and synergy of knowledge needed in our field (Klein et al., 1999).

Mixed-level approaches can provide a richer and more realistic understanding of e-collaboration (Klein et al., 1999). Because such approaches are parallel to the multilevel nature of actual e-collaboration practices, they will also tackle relevant issues with important practical implications for individuals, groups, organizations, and society (Hitt et al., 2007).

Another benefit of mixed-level research on e-collaboration is that it might bring collaboration across disciplines (Hitt et al., 2007). Because e-collaboration episodes are composed of elements occurring at multiple levels (Kock, 2005b), research into these different levels will benefit from experts on psychology and micro research issues, researchers on group and organizational issues, and researchers concerned with sociological issues. It is important to note, however, that such multidisciplinary collaborations represent a double-edge sword; although multidisciplinary research might provide deeper and comprehensive understandings of e-collaboration practices, it can entail some risks as well. As Klein et al. (1999, p. 244) explain that "an interdisciplinary and multilevel work may paradoxically be at home everywhere and nowhere: of some interest and appeal to numerous disciplines and journals but of central interest and appeal to none".

DISCUSSION

After having argued that e-collaboration is intrinsically a multilevel phenomenon, it might seem counterintuitive to still emphasize the importance for single-level research on e-collaboration. However, the goal of this article is not to criticize single-level research or censure its pursuit; the goal is to expose the level paradox of *exclusively conducting single-level research* on a multilevel phenomenon and the dangers associated with it. This is very different from stating that single-level research is not desirable or of interest to our discipline. In fact the opposite is true; single-level research has been critical for our understanding of e-collaboration. And it still is important. For example, single-level research has given us important insights into how processes and outcomes in e-collaboration are substantially different from those in face-to-face collaborative contexts (Webster & Staples, 2006). Furthermore, because mixed-level theories can "lack prediction accuracy in specific contexts" (Burton-Jones & Gallivan, 2007, p. 673), it is appropriate to conduct single-level research when more accuracy is needed over generalization.

Likewise, the scientific method of theory testing coupled with the scarcity of multi-

level theories (Goodman, 2000) points to the necessity of conducting single-level research to empirically examine our theories. Equally important is the fact that, from a practical standpoint, it is neither realistic nor desirable for researchers to exclusively commit and engage in more costly, complex, and larger in scope, mixed-level programs of research. Therefore, what might be needed when conducting single-level research is a careful justification of its appropriateness as well as explicit discussion of its generalizability (Klein et al., 1994).

What is important is that the mixed-level research is relevant for conducting single-level research. The mixed-level literature provides actionable ways in which constructs at higher levels (e.g., group) can be theoretically specified and empirically tested regardless of whether the research is single-level. Furthermore, it provides an adequate vocabulary for single-level researchers to explicitly and clearly state the levels of theory, measurement, and analyses in their studies.

It is worth noting that the level paradox, or the exclusivity of single-level research on e-collaboration, might be a consequence of the state of maturity of our field. E-collaboration, when compared other disciplines, is still in its infancy (Martins, 2004). For example, organizational behaviour is a much older field in which multilevel studies are only now flourishing (Bamberger, 2008). It is possible that as our field matures, the theories, analytical techniques, and data collected to answer research questions become more complex and thus include mixed-level possibilities.

The view of the field portrayed in this article is not free of limitations. One obvious shortcoming is that much of the review and discussion has been done from a positivistic and quantitative view of e-collaboration research to date. Thus important work carried out from interpretivist and qualitative approaches[4] that has included multilevel explanations of technology use and collaboration by individuals, groups, and organizations has been ignored (Orlikowski, 2000; Sarker, Valacich, & Sarker, 2005).

All in all, this article aims to draw attention to the single-level paradox of e-collaboration research, its potential dangers to build a cumulative knowledge tradition, and possible research opportunities from which to start the laborious task of building multilevel theories and research. Its purpose is not to advocate for the disappearance of single-level research but to find common ground in balancing our single-level view of e-collaboration by also conducting cross-level research. Such balance has the promise to close the gap that exists between issues of level in the e-collaboration field.

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REFERENCES

Alavi, M., Marakas, G. M., & Yoo, Y. (2002). A comparative study of distributed learning environments on learning outcomes. *Information Systems Research*, *13*(4), 404–415. doi:10.1287/isre.13.4.404.72

Bacharach, S. B. (1989). Organizational theories: Some criteria for evaluation. *Academy of Management Review*, *14*(3), 496–515.

Balthazard, P. E., Potter, R. E., & Warren, J. (2002). The effects of extraversion and expertise on virtual team interaction and performance. In *Proceedings of the 34th Hawaii International Conference on System Sciences*, Hawaii, HI (pp. 1-10).

Bamberger, P. (2008). Beyond contextualization: Using context theories to narrow the micro-macro grap in management research. *Academy of Management Journal*, *51*(5), 839–846. doi:10.5465/AMJ.2008.34789630

Baron, R. M., & Kenny, D. A. (1996). The moderator-mediatior variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*, 1173–1182. doi:10.1037/0022-3514.51.6.1173

Baskerville, R. (2006). Hacker wars: E-collaboration by vandals and warriors. *International Journal of e-Collaboration*, *2*(1), 1–16. doi:10.4018/jec.2006010101

Benbasat, I., & Zmud, R. W. (2003). The identity crisis within the IS discipline: Defining and communicating the discipline's core properties. *Management Information Systems Quarterly*, *27*(2), 183–194.

Benbunan-Fich, R., Hiltz, S. R., & Turoff, M. (2002). A comparative content analysis of face-to-face vs. Asynchronous group decision making. *Decision Support Systems*, *34*, 457–469. doi:10.1016/S0167-9236(02)00072-6

Bickel, R. (2007). *Multilevel analysis for applied research: It's just regression!*New York, NY: Guilford Press.

Boyle, R. J., Kacmanr, C., & George, J. F. (2008). Distributed deception: An investigation of the effectiveness of deceptive communication in a computer-mediated environment. *International Journal of e-Collaboration*, *4*(3), 14–39. doi:10.4018/jec.2008070102

Bryk, A. S., & Raudenbush, S. W. (1992). *Hierarchical linear models*. Newbury Park, CA: Sage.

Burke, K., & Chidambaram, L. (1999). How much bandwidth is enough? A longitudinal examination of media characteristics and group outcomes. *Management Information Systems Quarterly*, *23*(4), 233–246. doi:10.2307/249489

Burton-Jones, A., & Gallivan, M. J. (2007). Towards a deeper understanding of system usage in organizations: A multilevel perspective. *Management Information Systems Quarterly*, *31*(4), 657–679.

Cenfetelli, R., & Schwarz, A. (in press). Identifying and testing inhibitors of technology usage intentions. *Information Systems Research*.

Chan, D. (1998). Functional relations among constructs in the same content domain at different levels of analysis: A typology of composition models. *The Journal of Applied Psychology*, *83*(2), 234–246. doi:10.1037/0021-9010.83.2.234

Chen, G., & Bliese, P. D. (2002). The role of different levels of leadership in predicting self- and collective efficacy: Evidence for discontinuity. *The Journal of Applied Psychology*, *87*(3), 549–556. doi:10.1037/0021-9010.87.3.549

Chen, G., Bliese, P. D., & Mathieu, J. E. (2005). Conceptual framework and statistical procedures for delineating and testing multilevel theories of homology. *Organizational Research Methods*, *8*(4), 375–409. doi:10.1177/1094428105280056

Chen, G., Mathieu, J. E., & Bliese, P. D. (2004). A framework for conducting multi-level construct validation . In Yammarino, F. J., & Danserau, F. (Eds.), *Multi-level issues in organizational behavior and processes* (pp. 273–303). Amsterdam, The Netherlands: Elsevier Science. doi:10.1016/S1475-9144(04)03013-9

Chidambaram, L., & Jones, B. (1993). Impact of communication medium and computer support on group perceptions and performance: A comparison of face-to-face and dispersed meetings. *Management Information Systems Quarterly*, *17*, 465–491. doi:10.2307/249588

Danserau, F., & Yammarino, F. J. (1998). Introduction and overview . In Danserau, F., & Yammarino, F. J. (Eds.), *Leadership: The multiple-level approaches* (pp. xxv–xliii). Greenwich, CT: JAI Press.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, *35*(8), 982–1003. doi:10.1287/mnsc.35.8.982

Davis, J. A. (1966). The campus as a frog pond: An application of the theory of relative deprivation to career decisions of college men. *American Journal of Sociology*, *72*(1), 17–31. doi:10.1086/224257

de Leede, J., Kraan, K. O., den Hengst, M., & van Hooff, M. L. M. (2008). Conditions for innovation behaviour of virtual team members: A 'high road' for internationally dispersed virtual teams. *Journal of E-Working*, *2*, 22–46.

Easley, R. F., Devaraj, S., & Crant, J. M. (2003). Relating collaborative technology use to teamwork quality and performance: An empirical study. *Journal of Management Information Systems*, *19*(4), 249–270.

Enders, C. K. (in press). Missing not at random models for latent growth curve analyses. *Psychological Methods*.

Firebaugh, G. A. (1978). A rule for inferring individual-level relationships from aggregate data. *American Sociological Review*, *43*(4), 557–572. doi:10.2307/2094779

Firebaugh, G. A. (1980). Groups as contexts and frog ponds . In Roberts, K. H., & Burstein, L. (Eds.), *New directions for methodology of social and behavioral science* (*Vol. 6*, pp. 43–52). San Francisco, CA: Jossey-Bass.

Gallivan, M. J., & Benbunan-Fich, R. (2005). A framework for analyzing levels of analysis: Issues in studies of e-collaboration. *IEEE Transactions on Professional Communication*, *48*(1), 87–104.

Gefen, D., Geri, N., & Paravatsu, N. (2007). Vive la différence: The cross-cultural differences within us. *International Journal of e-Collaboration*, *3*(3), 1–15. doi:10.4018/jec.2007070101

Goodman, P. S. (2000). *Missing organizational linkages: Tools for cross-level research*. Thousand Oaks, CA: Sage.

Hitt, M. A., Beamish, P. W., Jackson, S. E., & Mathieu, J. E. (2007). Building theoretical and empirical bridges across levels: Multilevel research in management. *Academy of Management Journal*, *50*(6), 1385–1399. doi:10.5465/AMJ.2007.28166219

Hobman, E. V., Bordia, P., Irmer, B., & Chang, A. (2002). The expression of conflict in computer-mediated and face-to-face groups. *Small Group Research*, *33*(33), 4.

Hofmann, D. A. (1997). An overview of the logic and rationale of hierarchical linear models. *Journal of Management*, *23*(6), 723–744. doi:10.1177/014920639702300602

Hofmann, D. A., & Jones, L. M. (2004). Some foundational and guiding questions for multilevel construct validation . In Dansereay, F., & Yammarino, F. J. (Eds.), *Multi-level issues in organizational behavior and processes* (pp. 305–317). Amsterdam, The Netherlands: Elsevier Science. doi:10.1016/S1475-9144(04)03014-0

James, L. R. (1982). Aggregation bias in estimates of perceptual agreement. *The Journal of Applied Psychology*, *67*(2), 219–229. doi:10.1037/0021-9010.67.2.219

Keen, P. G. W. (1980). MIS research: Reference disciplines and a cumulative tradition. In *Proceedings of the First International Conference on Information Systems*, Philadelphia, PA.

Kirkman, B. L., Rosen, B., Tesluk, P. E., & Gibson, C. B. (2004). The impact of team empowerment on virtual team performance: The moderating role of face-to-face interaction. *Academy of Management Journal*, *47*(2), 175–192. doi:10.2307/20159571

Klein, K. J., Bliese, P. D., Kozlowski, S. W. J., Dansareay, F., Gavin, M. B., & Griffin, M. A. (2000). Multilevel analytical techniques: Commonalitites, differences, and continuing questions . In Klein, K. J., & Kozlowski, S. W. J. (Eds.), *Multilevel theory, research, and methods in organizations* (pp. 512–553). San Francisco, CA: Jossey-Bass.

Klein, K. J., Danserau, F., & Hall, R. J. (1994). Levels issues in theory development, data collection, and analysis. *Academy of Management Review*, *19*(2), 195–229.

Klein, K. J., & Kozlowski, S. W. (2000). From micro to meso: Critical steps in conceptualizing and conducting multilevel research. *Organizational Research Methods*, *3*(3), 211–236. doi:10.1177/109442810033001

Klein, K. J., Tosi, H., & Cannella, A. A. J. (1999). Multilevel theory building: Benefits, barriers, and new developments. *Academy of Management Review*, *24*(2), 243–248. doi:10.5465/AMR.1999.1893934

Ko, I., Olfman, L., & Choi, S. (2009). The impacts of electronic collaboration and information exploitation capability on firm performance: Focusing on suppliers using buyer-dominated interorganizational systems. *International Journal of e-Collaboration*, *5*(2), 1–17. doi:10.4018/jec.2009040101

Kock, N. (2005a). Expanding the boundaries of e-collaboration. *IEEE Transactions on Professional Communication*, *48*(1), 1–9. doi:10.1109/TPC.2004.843272

Kock, N. (2005b). What is e-collaboration? *International Journal of e-Collaboration*, *1*(1), i–vii.

Kozlowski, S. W., & Klein, K. J. (2000). *Multilevel theory, research and methods in organizations: Foundations, extensions, and new directions*. San Francisco, CA: Jossey-Bass.

Kristensen, K., & Kijl, B. (2010). Collaborative performance: Addressing the ROI of collaboration. *International Journal of e-Collaboration*, *6*(1), 53–69. doi:10.4018/jec.2010091104

Limayem, M., & DeSanctis, G. (2000). Providing decisional guidance for multicriteria decision making in groups. *Information Systems Research*, *11*(4), 386–401. doi:10.1287/isre.11.4.386.11874

Luke, D. A. (2004). *Multilevel modeling*. Thousand Oaks, CA: Sage.

MacKinnon, D. P. (2008). Multilevel mediation models . In McKinnon, D. P. (Ed.), *Introduction to statistical mediation analysis* (pp. 237–274). New York, NY: Routledge.

Markus, M. L. (1994). Electronic mail as the medium of managerial choice. *Organization Science*, *5*(4), 502–527. doi:10.1287/orsc.5.4.502

Markus, M. L. (2005). Technology-shaping effects of e-collaboration technologies: Bugs and features. *International Journal of e-Collaboration*, *1*(1), 1–23. doi:10.4018/jec.2005010101

Martins, L. L. (2004). Virtual teams: What do we know and where do we go from here? *Journal of Management*, *30*(6), 805–835. doi:10.1016/j.jm.2004.05.002

Masetti, B., & Zmud, R. W. (1996). Measuring the extend of EDI usage in complex organizations: Strategies and illustrative examples. *Management Information Systems Quarterly*, *4*(1), 95–105.

Mathieu, J. E. (2007). The effects of leader empowering behavior, members' experience, and virtuality on sales team processes and performance. In *Proceedings of the Academy of Management*, Philadelphia, PA.

Mathieu, J. E., Maybard, M. T., Taylor, S. R., Gibson, L. L., & Ruddy, T. M. (2007). An examination of the effects of organizational district and team contexts on team processes and performance: A meso-mediational model. *Journal of Organizational Behavior*, *28*(7), 891–910. doi:10.1002/job.480

Mathieu, J. E., & Taylor, S. R. (2007). A framework for testing meso-mediational relationships in organizational behavior. *Journal of Organizational Behavior*, *28*, 141–172. doi:10.1002/job.436

Morgeson, F. P., & Hofmann, D. A. (1999). The structure and function of collective constructs: Implications for multilevel research and theory development. *Academy of Management Review*, *24*(2), 249–265.

Muthén, B., Asparouhov, T., Hunter, A., & Leuchter, A. (in press). Growth modeling with non-ignorable dropout: Alternative analyses of the STAR*D antidepressant trial. *Psychological Methods*.

Orlikowski, W. J. (2000). Using technology and constituting structures: A practice lens for studying technology in organizations. *Organization Science*, *11*(4), 404–428. doi:10.1287/orsc.11.4.404.14600

Ortiz de Guinea, A., & Webster, J. (2011). Are we talking about the task or the computer? An examination of the associated domains of task-specific and computer self-efficacies. *Computers in Human Behavior*, *27*(2), 978–987. doi:10.1016/j.chb.2010.12.002

Ortiz de Guinea, A., Webster, J., & Staples, D. S. (2005). *A meta-analysis of the virtual team literature*. Paper presented at the High Performance Professional Teams Symposium, Industrial Relations Centre, School of Policy Studies, Queen's University, Kingston, ON, Canada.

Otondo, R. F., Barnett, T., Kellermans, F. W., Pearson, A. W., & Pearson, R. A. (2009). Assessing information technology use over time with growth modeling and hierarchical linear modeling: A tutorial. *Communications of the Association for Information Systems*, *25*(1), 45.

Peugh, J. L., & Enders, C. K. (2005). Using the spss mixed procedure to fit cross-sectional and longitudinal multilevel models. *Educational and Psychological Measurement*, *65*(5), 717–741. doi:10.1177/0013164405278558

Powell, A., Piccoli, G., & Ives, B. (2004). Virtual teams: A review of current literature and directions for future research. *The Data Base for Advances in Information Systems*, *35*(1), 6–36.

Rodell, J. B., & Judge, T. A. (2009). Can "good" stressors spark "bad" behaviors? The mediating role of emotions in links of challenge and hindrance stressors with citizenship and counterproductive behaviors. *The Journal of Applied Psychology*, *94*(6), 1438–1451. doi:10.1037/a0016752

Rousseau, D. M. (1985). Issues of level in organizational research: Multi-level and cross-level perspectives . In Staw, B. M., & Cummings, L. L. (Eds.), *Research in organizational behavior* (*Vol. 7*, pp. 1–37). Greenwich, CT: JAI Press.

Sarker, S., Valacich, J. S., & Sarker, S. (2005). Technology adoption by groups: A valence perspective. *Journal of the Association for Information Systems*, *6*(2), 37–71.

Seibert, S. E., Silvert, S. R., & Randolph, W. A. (2004). Taking empowerment to the next level: A multiple-leveled model of empowerment, performance, and satisfaction. *Academy of Management Journal*, *47*(3), 332–349. doi:10.2307/20159585

Short, J. S., Piccolo, G., Powell, A., & Ives, B. (2005). Investigating multilevel relationships in information systems research: An application to virtual teams research using hierarchical linear modeling. *Journal of Information Technology Theory and Application*, *7*(3), 1–17.

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Boston, MA: Pearson Education.

Treviño, L. K. W., J., & Stein, E. W. (2000). Making connections: Complementary influences on communication media choices, attitudes, and use. *Organization Science*, *11*(2), 163–182. doi:10.1287/orsc.11.2.163.12510

Valacich, J. S., Sarker, S., Pratt, J., & Groomer, M. (2002). Computer-mediated and face-to-face groups: Who makes riskier decisions? In *Proceedings of the 35th Hawaii International Conference on System Sciences*, Hawaii, HI (pp. 133-142).

Wakefield, R. L., Leidner, D. E., & Garrison, G. (2008). A model of conflict, leadership, and performance in virtual teams. *Information Systems Research*, *19*(4), 434–455. doi:10.1287/isre.1070.0149

Walczuch, R. M., & Watson, R. T. (2001). Analyzing group data in mis research: Including the effect of the group. *Group Decision and Negotiation*, *10*, 83–94. doi:10.1023/A:1008765029795

Webster, J., & Staples, D. S. (2006). Comparing virtual teams to traditional teams: An identification of new research opportunities . In Martocchio, J. J. (Ed.), *Research in personnel and human resources management* (*Vol. 25*, pp. 181–215). Oxford, UK: Elsevier.

Webster, J., & Treviño, L. K. (1995). Rational and social theories as complementary explanations of communication media choices: Two policy capturing studies. *Academy of Management Journal*, *38*, 1544–1572. doi:10.2307/256843

Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *Management Information Systems Quarterly*, *26*(2), xiii–xxiii.

Whetten, D. A. (1989). What constitutes a theoretical contribution. *Academy of Management Review*, *14*(4), 490–495.

Yammarino, F. J., & Markham, S. E. (1992). On the application of within and between analysis: Are absence and affect really group-based phenomena? *The Journal of Applied Psychology*, *77*, 168–176. doi:10.1037/0021-9010.77.2.168

ENDNOTES

1 A related issue worth mentioning is the disaggregation of data or the "breaking down of information at one level by assigning its component parts to individual units at a lower level" (Rousseau, 1985, p. 5). One problematic issue of these data is the violation of the independence of observation assumption, explained earlier (Hofmann, 1997). Another problematic issue of disaggregated data is that biases can arise when calculating statistical estimates because such estimates are based on the total number of lower-level units (Hofmann, 1997)

2 It is important to note that normative functions and comparative functions – explained earlier – can cancel each other (Firebaugh, 1980). The difference between normative and comparative functions is explained as follows by Rousseau (1985, p. 10): "Generally, normative effects result from appraisal or evaluation of one's relative standing in a group. Unlike comparative functions which assume that all individuals in a unit are equally affected by some composite unit characteristic, normative effects assume differences in individual responses according to one's relative standing".

3 Perhaps because they can be thought of as an extension of cross-level direct effects models.

4 This paragraph points only to the fact that much of the positivist research uses quantitative methodologies and that much of interpretivist research employs qualitative data. This does not mean, however, that philosophical approaches to science and theory have a one-to-one relation with method. For example, it is possible to conduct positivist research with qualitative data.

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E-Collaboration Within, Between, and Without Institutions:
Towards Better Functioning of Online Groups Through Networks

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ABSTRACT

This paper discusses different ways for the exchange of knowledge in networks - within, between, and without institutions, as well as their implication on networks in economy and society. Network systems based on technologies and architectures of participation offer a new model of online knowledge sharing, cooperation, and collaboration, that are different from the traditional institutional framework. This paper suggests that this model opens new horizons for both companies and non-profit organizations. By developing an e-networked business model, companies can make as much or even more money in the long tail of power low distribution than they were making at the head of the curve in the traditional business model. This opens to everyone the possibility of participating and contributing content, non-profit organization and online communities, including Communities of Practice and online learning communities, which can ensure reaching the "critical mass" of contributors and involvement level that will keep these communities active. This paper concludes with an example illustrating how the ideas discussed could facilitate knowledge exchange in companies, organization or educational institutions.

Keywords: *Collaboration, Content Contribution, Cooperation, E-Networked Business Model, Long Tail of Peer-Production, Online Knowledge Sharing, Network Systems*

INTRODUCTION

The clear boundary between creators and consumers of online content has blurred in the past decade because of the enormous expansion of a new culture - the participatory culture. Jenkins et al. (2006b) define the participatory culture as one in which members believe their contributions matter, and feel some degree of social connection with one another. Community and knowledge management are two features that online environment can do much better than its physical counterpart (Chen & Tsai, 2009). The Web 2.0 is an information space through which people can communicate by sharing their knowledge and ideas in a common pool and find items shared by others. Network technologies allow geographically dispersed users in companies, organizations, and communities of practice to communicate, share their knowledge, cooperate, and collaborate online in order to work or learn together (Bouras, Giannaka, & Tsiatsos, 2009).

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As a response to a key social value of participatory literacy at the 21st century workplace, educational practitioners, and researchers have demonstrated a growing interest in developing pedagogical practices enhancing a participatory culture in all levels of education (Coiro, Knobel, Lankshear, & Leu, 2008). Differing from the traditional whereby compulsory and higher education are based on lectures and individual assignments; the emergence of a participatory culture at schools, colleges, and universities changes the focus of literacy from individual expression to collaboration and community involvement (Jenkins, 2006a).

Mediated collaboration is not limited to computer mediated communication (CMC). Kock, Davison, Ocker, and Wazlawick (2001) suggested a broad definition of e-collaboration as "a process of collaboration among individuals engaged in a common task using electronic technologies". According to Kock and Nosek (2005), not only computers, but many other electronic technologies can be used to support collaboration among individuals engaged in a common task.

A variety of electronic technologies now enable different types of coordination and knowledge exchange. First this paper will make the distinction between the different forms of knowledge exchange through information technologies. Following that, different ways of exchanging knowledge in networks - within, between, and without institutions, as well as their implication on networked economy and society will be discussed. Motivation for contributions will be presented and e-collaboration through networked systems which will be examined from different perspectives - synchronous versus asynchronous knowledge exchange, continuous versus one-time contribution, active community involvement and content contribution versus lurking. The paper concludes with an example illustrating how the ideas discussed could facilitate knowledge exchange in companies, organization or educational institutions.

SHARING, COOPERATION, AND COLLABORATION

Some authors use the term "knowledge sharing" in a broad sense – as the process of mutually exchanging knowledge and jointly creating new knowledge (van den Hooff & de Ridder, 2004). However, exchange and creating knowledge through information technology have different forms and it is important to make a distinction between the processes of knowledge sharing, cooperation, and collaboration. **Knowledge sharing** is the provision or receipt of task information, know-how, and feedback regarding a product or procedure (Hansen, 1999), "an activity where agents - individuals, communities, or organizations - exchange their knowledge - information, skills, or expertise" (Ireson & Burel, 2010, p. 351). Examples of knowledge sharing through information technology are Flikr and YouTube where participants contribute pictures or video clips to the system and other users can retrieve their output. **Cooperation** described as working on a task that is accomplished by dividing it among participants, where "each person is responsible for a *portion* of the problem solving" [*emphasis added*] (Roschelle & Teasley, 1995, p. 70). An example of online cooperation is the development of Linux, in which different programmers around the world improve the *same* open-source system by contributing *different* patches or fixing *different* bugs. **Collaboration**, in contrast, is defined as "a method that implies working in a group of two or more to achieve a common goal, while respecting each individual's contribution to the *whole*" [*emphasis added*] (McInnerney & Robert, 2004, p. 205). An example of e-collaboration process is the Wikipedia project in which groups of users write and edit the *same entries* improving their quality and correcting errors.

The results of collaborative production tend to be more profound compared to sharing or cooperation (Caspi & Blau, in press; Ingram & Hathorn, 2004). Shirky (2009) pointed to

the fact that collaborative production, where people have to coordinate with one another to get anything done, is considerably harder than simple knowledge sharing and cooperation. The author argued that compared to more passive cooperative activities, working collaboratively on the same task places more cognitive and interpersonal demands on participants.

In learning settings, working collaboratively, participants build a new knowledge by defending their ideas and by challenging other learners. According to Ingram and Hathorn (2004), the outcomes of successful collaborative learning process are qualitatively different from what any individual could produce alone.

However, collaboration often does not come naturally to participants, especially in cultures that cultivate individual accountability and responsibility. In most companies, it is difficult to encourage employees to collaborate and even cooperate with others; they avoid sharing resources or customers on tasks with little recognition of individual input (Hansen, 2009). Similarly, many learners prefer using a "divide and conquer" cooperative strategy to prepare their part of the group project (Blau & Caspi, 2009). This strategy can be useful working on assignment, but it tends to lose most of the advantages of collaborating throughout the entire learning process (Ingram & Hathorn, 2004).

Blau and Caspi (2009) argued that discussing the preferences for knowledge sharing, cooperation, and collaboration is important when taking into consideration the sense of psychological ownership. Psychological ownership is "the state in which individuals feel as though the target of ownership or a piece of that target is 'theirs'" (Pierce, Kostova, & Dirks, 2003, p. 86). This sense of possession is not restricted to physical objects, but may be felt toward information (Raban & Rafaeli, 2007), words, ideas, creations, or academic products (Pierce et al., 2003). Compare to knowledge sharing and cooperation, editing collaborative documents has the higher level of intrusion and decreases the sense of psychological ownership (Caspi & Blau, in press). Thus, participants may avoid collaboration partly because they do not want to lose a sense of personal ownership or to reduce the ownership of others.

Knowledge Exchange in Networks: Within, Between, and Without Institutions

The knowledge sharing research and practice using information and communication technologies (ICT) traditionally has been focused on the knowledge exchange within and between professional organizations (Ireson & Burel, 2010). The Web 2.0 applications extended these possibilities promoting online interactions and knowledge exchange in three ways: (1) between employees *within* organization or group of organizations, (2) *between* the organization and users of its products or services, and (3) between users themselves, creating a network based on user-to-user coordination, *without* forming an institution.

Online interactions and knowledge exchange *within* organizations often happened in the form of online projects. Deepwell and King (2009) defined online project management as "processes employing a virtual infrastructure to plan, manage, and control the activities of a project team which may be geographically and/or temporally dispersed" (p. 12). Online collaboration tools help teams to build virtual workspaces where the group members can work on projects, collectively author, edit, and review materials (Fichter, 2005). These virtual workspaces can include member profiles, online discussion groups, file-sharing areas, integrated calendaring, and collaborative authoring tools. For example, providing commentaries on a particular subject in interactive format through a blog can increase information sharing in organizations (Bouras, Giannaka, & Tsiatsos, 2009). Some organizations encourage executives or experts posting their preliminary thoughts and ideas in blogs in order to start discussion and information exchange both inside and outside the organization.

Using network technologies for online interactions and knowledge exchange *between* the organization and users of its products or

services, institutions strengthen connections with their potential target audience and in some cases encourage active participation and/or content contribution by users. This model of audience involvement can be adapted whether by economic institutions such as firms, cooperatives, unions, by political organization such as parties, governing bodies, agencies, or by social institutions such as religious organizations, associations, and clubs (Ulieru & Verdon, 2009). In the traditional version of this model, organizations broadcast to all users regardless of the individual user needs, while users just provide a reaction to the organization activities (Ireson & Burel, 2010). This process based on two-way communication: Providing relevant information by organization to individuals or groups of users, and receiving user feedback on the products or services provided by the organization. Ireson and Burel however argued that some organizations realized the potential benefits offered through harnessing the power of the potential customers of their products and services. Thus, in an advanced version of this model, users can be pro-actively engaged in the decision-making process determining the nature, importance, extent of issues and opportunities faced by organizations, as well as the mode in which activities of organizations are carried out. Ireson and Burel (2010) give an example of "Johnson & Johnson" company setting up the Baby Center - global interactive parenting network, where the company consumers are actively engaged in conversations to solicit information on given topics. Ulieru and Verdon (2008) argued that embracing the power of decentralized user-generated content supported by network technologies, institutions are shifting from the 'command economy' to the 'e-networked industrial ecosystem'. However, the connections and interdependencies between people and institutions give rise to new patterns of interaction and challenge the hierarchical top-down management business model (Shirky, 2009).

There is a relatively new trend of pushing the processes of knowledge sharing, cooperation, and collaboration into the infrastructure (Coleman & Levine, 2008). In this model technologies create online networks based on user-to-user coordination, *without* forming institutions and shift the world from the industrial to the networked society and economy (Ulieru & Verdon, 2009). A network system coordinates the output of the group as a byproduct of operating the system, avoiding difficulties and costs related to running an institution. According to Shirky (2009), additional advantages of this collaboration mode are: Including all the participants in the process of knowledge exchange and collaboration instead of hire professionals only in institutional model, taking a problems to the participants around the world rather then moving them to the institution for solving the problems, and replacing long-term planning and the necessity of deciding in advance with point-to-point coordination.

User-generated content networks such as YouTube, Flikr, and Wikipedia are examples of this growing trend of using a network infrastructure for knowledge sharing, cooperation, and collaboration, without forming an institution. YouTube.com is a way of upload, share, and tag videos worldwide, with more than 100 million videos being watched every day (Cheng, Dale, & Liu, 2008). YouTube has been online since 2005 and by the time of this writing, according to the three-month traffic rankings (Alexa.com), the website is ranked as number 3 in the world. Weinberger (2007) mentioned that Flickr.com - user-generated picture platform - have approximately 225 million images uploaded by users with almost one million being added every day. The platform contains picture galleries available with chat, groups, tag, and photo ratings (Alexa.com). Wikipedia project started in 2001 and now it is the world's largest encyclopedia with about 15 millions of articles in 250 languages and over 3.5 million articles in the largest English version. The website is ranked as number 8 in the world according to the three-month Alexa.com traffic rankings. Ulieru and Verdon (2009) explained the fast growing and updating of the Wikipedia by relatively costless coordination and self-organization, as well as by editing

history transparency of the wiki technology. Wikipedia contains features that enable co-authoring and collaboration (Rafaeli, Hayat, & Ariel, 2009). Thus, the system allows anyone (registered as well as anonymous and occasional users) to add, change or delete content in any of the articles and saves a detailed history of changes. Instead of professional editors, visitors are collectively monitoring the content. Participants, who have interest in specific topics, may purposefully follow recent changes and traffic in articles related to this topic. The quality of outcomes after the collaboration in networks is high and explained in the literature by "wisdom of crowds" (Surowiecki, 2004).

User-generated tags is the answer of online networks to the problem of classification in file-sharing areas, the way in which the infrastructure coordinates contributions of users and make possible to find and retrieve them (Shirky, 2009). For example, Flickr has not only almost one million pictures being added every day, but also 5.7 million tags applied (Weinberger, 2007). YouTube platform uses tags, titles, and descriptions of the videos to find related clips (Cheng et al., 2008). Allowing the users to upload and characterize their content is an especially effective way to access the needed content in cases when only a small fraction of people possess the output we are interested it (Shirky, 2009).

E-Collaboration in a Networked Economy: Using the Long Tail of Peer-Production

The future of business is selling more of less (Anderson, 2008).

As mentioned earlier, network systems based on technologies and architectures of participation offer a new model of e-collaboration, which is completely different from the existing institutional framework (Shirky, 2009; Ulieru & Verdon, 2009). This new model can be coined within the power-law distribution known as 80-20 rule (Pennock et al., 2002). According to the rule, for some natural phenomena about 80% of the effects come from approximately 20% of the causes.

Productivity in networked systems follows the same type of power-low distribution (Ulieru & Verdon, 2009). While sales are decreasing and costs increasing, traditional hierarchic institutions can no longer be viable. Therefore organizations using traditional business model hire the most talented and productive people available within the constraints of the cost-value threshold.

The model based on network technologies adapts a different approach and tend to capitalize the whole curve of potential productivity by reaping the aggregated value of the many people, including many participants who make only one contribution (Shirky, 2009). This new mode of production rooted in network technologies as platforms of near costless coordination, maximizes organizational capability and uses a long tail of peer-production as a synergetic 'force multiplier' (Ulieru & Verdon, 2009).

However, researchers predict (Shirky, 2009; Ulieru & Verdon, 2009) that the traditional hierarchic organizations will not be completely displaced by the model based on network technologies and user participation only, instead of forming an institution. Rather online networks offer the traditional business model a new platform for coordinating efforts of contributors, using a long tail of peer-production and building networked economy. These mixed companies may *coexist* with online communities based on user-to-user coordination, without forming institutions.

E-Collaboration in Networked Society

E-collaboration in networked society is primarily concerned with facilitating e-government and knowledge exchange process in Communities of Practice (CoP) - "normally professional, social grouping whose members work actively on a shared interest, solving shared problems, sharing and constructing knowledge over time" (Deepwell & King, 2009, p. 12). Considering

e-government, the majority of the research focuses on either intra- and inter-organizational knowledge exchange using ICT, or explores how different technologies can improve the communication from organizations to citizens (Vitvar et al., 2010). Thus, investigating networked society, it seems that research still focuses on two traditional forms of online interactions, knowledge exchange, and e-collaboration mentioned above: between employees *within* organization, as well as *between* the organization and users of its products or services.

Taking advantage of users and adapting a model based on network technologies, knowledge become a property of CoP - groups of people with shared interests, who benefit from knowledge exchange and collaboration (Ireson & Burel, 2010). Technological tools are used by members of CoP on order to identify specific information and experts, share successes and develop best practices, exchange thoughts and replicate ideas. These communities function as informal networks of individuals who share a common set of information needs or problems. Thus, CoP can be characterized as the third model presented above- a network based on user-to-user coordination, *without* forming institutions. Ireson and Burel argued that to support CoP and make them effective it is important to choose knowledge management tools that allow efficacious interactions and intuitive access to the shared knowledge database. An example of community with effective technological platform is Wikipedia, which fit into the category of CoP by forming a social collective of individuals that deal with similar problems that matter to them (Rafaeli, Hayat, & Ariel, 2009). These characteristics of CoP, as well as the sense of community that the participants share, foster the process of e-collaboration and knowledge building taking place in the Wikipedia.

CoP function in networked society as engines for development of social capital (Lesser & Storck, 2001). *Social capital* is "the actual and potential resources individuals obtain from knowing others, being part of a social network with them, or merely being known to them and having a good reputation" (Baron & Markman, 2000, p. 107). Findings of Ardichvili, Page, and Wentling (2003) suggest that online CoP strengthen the social capital by enhancing the ties between people who have met earlier face-to-face, but due to geographical distance or other reasons would not have kept in touch. Lesser and Storck (2001) identify performance outcomes associated with CoP they studied and link these outcomes to the basic dimensions of social capital. These dimensions include: connections among practitioners who may or may not be co-located, relationships that build a mutual obligation and sense of trust, as well as a common language and context that can be shared by community members. The authors argue that the social capital that is present in CoP leads to behavioral changes, which in turn improve organizational performance and create organizational value.

However, the model based on network infrastructure is value neutral; in some cases this may lead to negative consequences and even contradict rules of society (Shirky, 2009). For example, network infrastructure equally supports programmers improving open source software code, as well as hackers who share tips on how to program a computer virus or break into security networks. It allows online support for people having different health problems, as well as for groups like ProAna, a community of teenage girls that try to maintain their anorexia by choice and use the network for "thinspiration" - sharing diets, tips, and pictures of thin models. It is important to be aware not only of the advantages, but also the disadvantages and downsides of technological infrastructures in an e-network society.

Synchronous Versus Asynchronous E-Collaboration

Information exchange is not only held within documents and networked systems, but also in inter-personal and group dialogues among people (Ireson & Burel, 2010). During these dialogues via electronic technologies, different communication channels are used: Synchronous

communication that supports real-time interactions (e.g., video conferencing, audio conferencing, textual chat), as well as asynchronous communication that supports 24/7 interactions (e.g., email, SMS, forum, blog, wiki, twitter). Kock (2010) argued that e-collaboration technologies based on textual interactions without supporting oral speech leads to two negative consequences when knowledge exchange is attempted: (1) a decrease in communication fluency and (2) an increase in communication ambiguity. Kock claimed that the negative effects of absence oral speech are particularly strong in short-term collaborative tasks and need to be taken into consideration when choosing collaborative technology. Consistent with this claim, Blau and Barak (2010) found lower communication fluency in short-term knowledge exchange in groups interacting through textual chat compared to groups communicating through audio conferencing.

Some networked systems support both synchronous and asynchronous form of sharing knowledge and/or collaboration. For example, the Google Docs application allows access from any computer and eases sharing documents with specific participants or publishing them on the web were everyone can find and retrieve them (Conner, 2008). In addition to the file-sharing function, Google Docs affords synchronous as well as asynchronous cooperation and collaboration by supporting easy editing, comment writing, and saving versions of the document (Blau & Caspi, 2009). Flexible systems supporting synchronous as well as asynchronous communication are prominent for both work and learning purposes, since using the same network the participants can choose the most convenient form of interaction and collaboration for each task.

Continuous Versus One-Time Contribution

As mentioned above, the model of collaboration in a networked economy can be coined within the power-law distribution. Therefore a very large number of participants in a networked economy model make only one-time contributions to their communities, while the traditional institutional model is based exclusively on continuous contribution (Shirky, 2009). For example, exploring the efforts behind the development of Linux, Microsoft discovered that the majority of programmers made only one contribution to the system. Commenting on this fact, Ulieru and Verdon (2009) pointed out that the long tail of Linux's e-networked productivity model makes possible the contribution of millions of programmers, without significant additional transaction and coordination costs. Moreover, the potential of including every programmer around the world in its development of Linux, leads in some cases to really essential one-time improvements, such as contributing important security patches or fixing serious bugs. Traditional organizational business models give up this value because it cannot tolerate workers that contribute once in several years, even if their contribution is priceless (Ulieru & Verdon, 2009; Shirky, 2009).

Similarly, the capacity of the Wikipedia project to grow, keep articles up to date, and correct errors far exceeds the capacity of Encyclopedia Britannica to do the same. The most recent 15th edition of Encyclopedia Britannica was published in 1985; the Wikipedia project started in 2001 and its growth in terms of volume, number of articles, and percentage of contributors has been very impressive. By the time of this writing, the largest English version of Wikipedia contains more than 3.5 million articles, the German version- 1.5 million articles, French versions more than a million articles and Spanish, Italian, Portuguese, Chinese, Dutch, Polish, and Russian versions - over half a million articles each. For comparison, only a few years ago Rafaeli and Ariel (2008) reported about significantly less content in Wikipedia: Two million articles in English, more than half a million articles in German, and more than 100,000 in other languages mentioned above. Benkler (2006) explained the rapid growth of the Wikipedia project by adapting the networked model: "The shift in strategy toward an open, peer-produced model proved enormously suc-

cessful. The site saw tremendous growth both in the number of contributors, which included the number of active and very active contributors, and the number of articles included in the encyclopedia" (p. 71). However, despite the fact that number of active and very active contributors of Wikipedia is growing rapidly, similarly to other social phenomena with power-law distribution, the ratio of contributors that keep the community active is low. About 2.5% of Wikipedia users contribute 80% of all the content and only 1% of the users generated 50% of the content (Tapscott & Williams, 2007).

The model of networked collaboration using a one-time contribution of many participants works not only for open-source development communities or non-profit projects and organization. For example, developing an e-networked business model, Amazon.com discovered that they were able to make as much or even more money in the long tail of their book sales than they were making in the head of the curve (Ulieru & Verdon, 2009). The Amazon.com website has been online since 1994. By the time of this writing, according to Alexa.com, Amazon's three-month global traffic rank is 14 and 5 in US. It turns out that once the network was built, coordination costs of Amazon decreased significantly and as the network business grew, they totally collapsed (Ulieru & Verdon, 2009). Amazon has numerous personalization features and services including one-click buying, extensive customer and editorial product reviews, seeking to be the most customer-centric company, where customers can find and discover anything they might want to buy online by the lowest possible prices (Alexa.com).

These examples of open-source program development such as Linux, community of practice writing online encyclopedia such as Wikipedia, and company developing an e-networked business model such as Amazon, show the possibility of success based on the long tail – a very large number of participants' one-time contribution through the networked infrastructure.

Content Contribution and Involvement: Expectations and Explanations

Ingram and Hathorn (2009) claimed that in learning settings, an indispensible element of collaboration is that all learners involved in a collaborative task must contribute more or less *equally*. However, due to the lack of content contributors, online communities have serious problems in sustaining the community active (Rafaeli & Ariel, 2008). Adar and Huberman (2000) argued that the cyberspace is overloaded with empty communities and with communities where many of the participants are "free riders" or "lurkers". Moreover, according to these researchers, free riding leads to degradation of the community performance and may collapse such a networked system. Indicating the disproportion of content contribution and community involvement, Peddibhotla and Subramani (2007) claim that a "critical mass" of contributors is needed to maintain a community active.

Other researchers (Rafaely & Ariel, 2008; Shirky, 2009), however, pointed to the fact that in networked systems the participation is non-mandatory and people contribute as much as they like. Therefore in communities with user-generated content typically is observed a *power low distribution* of participation and content contribution. For example, studying the temporal evolution of two online communities and the changes in the communication activity of their users on a longitudinal basis, Schoberth, Heinzl, and Rafaeli (2011) found that a small portion of participants possess a large number of connections, while the majority of the community members hold only very few connections. The distribution of content contribution is extremely skewed also among writers of articles in the open community around the world such as Wikipedia (Ravid, 2007). Similarly, a power low distribution was find in relatively small learning community of undergraduates in three

Universities collaboratively writing and updating Wiki-books, instead of using traditional text-books written by others (Ravid, Kalman, & Rafaeli, 2008). Skewed distribution was also found among the "digital generation" of elementary school students when interacting, sharing, and collaborating with other children in a small online learning community preparing Scratch programming media projects (Zuckerman, Blau, & Monroy-Hernández, 2009). It seems that the power low distribution is neither restricted to the text medium nor to the participant age.

Schoberth, Heinzl, and Rafaeli (2011) tried to identify an analytical model able to fit power low distributions in online communities and explain their causes. They found that the theoretical model by Pennock et al. (2002) which unites two approaches - Scale-free Networks and Random Network Theory, allows the operationalization of member activity distribution. Moreover, the Pennock et al.'s model explain functions of the communication activity in communities with only one free parameter- the mixing factor α, which represents the ratio between the antagonists- homogeneity and heterogeneity. Authors found that in both larger and smaller communities the mixing factor α and therefore the level of heterogeneity, were relatively stable over time (Schoberth et al., 2011). However, they also discovered that participants in both communities prefer to interact and collaborate with members having many communication partners, while members with low activity are less attractive for interaction. This finding is consistent with general striking "rich get richer" behavior observed on the Internet, e.g., when a relatively small number of websites receiving a disproportionately large share of traffic and hyperlink references (Pennock et al., 2002). According to Schoberth et al. (2011), this phenomenon was stronger in a large online community - it members had almost twice as many connections as those of a small community. Authors concluded that compared to the large network, the tighter community might lead to the more homogeneous distribution of its activity.

Motivation for E-Collaboration

To develop an effective networked system it is essential to consider the motivation of the users for sharing their knowledge and collaborating with others (Ireson & Burel, 2010). However, Rafaeli and Ariel (2008) noted that studies of incentives for participation and content contribution are limited. Describing motivation of the Wikipedia contributors, Ciffolilli (2003) distinguished between personal and social motivation. *Personal* motivation factors involve satisfaction, self-efficacy, and intrinsic drive to acquire knowledge. *Social* motivation factors include a desire to participate in producing collective good, a need for support, and a need for belonging to the group. *Uses and Gratifications* approach is a theoretical framework for examining media users and investigating how people use the media to gratify their needs. Rubin's uses and gratification approach (1994) suggested five generic motivation clusters of needs that media could fulfill: cognitive, affective, personal integrative, social integrative, and diversion needs. Rafaeli and Ariel (2008) and Rafaeli, Hayat, and Ariel (2009) expanded uses and gratification approach for analyzing online environments, attempting to identify the cognitive and social-integrative motivators for active participation in Wikipedia. Based on uses and gratification approach, Zuckerman, Blau, and Monroy-Hernández (2009) explored *cognitive versus social* motivators for content contribution among children and youth producing programming media in the Scratch online community. Stafford, Stafford and Schkade (2004) emphasized the role of cognitive gratification of online communities - the desire for information acquisition – and argued that it is one of the principal motivators for participation and content contribution. In contrast, Blau, Zuckerman, and Monroy-Hernández (2009) found that children in Scratch community gratify different forms of social participation, but not a cognitive contribution.

Other researchers suggest a different perspective grounded on their empirical data.

Joyce and Kraut (2006) suggested that newcomers' interaction with a group through initial postings followed by responses of other community members will be a first step in building their commitment to the group. This claim was empirically proved by Burke, Marlow, and Lento (2009) through log analysis of approximately 140,000 newcomers on Facebook, a social networking website. Their findings on Facebook indicate that receiving feedback on a newcomer's contribution was a significant predictor of subsequent content contribution.

Although there are different type of motivation for different users of an e-collaboration system, generally, in organizations there is an expectation of some *extrinsic* reward (external-oriented motives, e.g., enhance reputation, social ranking, competition, social affiliation, reciprocity, expected economic and organizational rewards) for any knowledge shared (Palmisano, 2008). In community-based systems, incentives become less significant, while the *intrinsic* motivation to participate and share knowledge (self-oriented motives, e.g., self expression, personal development, utilitarian motives, economic motives, and knowledge efficacy) becomes more important. Consistent with this claim, the assessment of Wikipedians' motivation (Rafaeli, Hayat, & Ariel, 2009) indicated that at least two motivators ("sharing my knowledge" and "contributing to others") ranked high in comparison to other motivation descriptors, had a selfless flavor. The researchers concluded that, at least partially, contribution to Wikipedia CoP based on altruistic sharing and collaborative reasons.

Different factors, such as *communication medium*, *personal traits,* and the *characteristics of the task*, may influence on individual online behavior and motivation for contribution in communities. Blau and Barak (2009) found that participant personality affected their willingness to partake in group interacting online: Extroverts and neurotic participants preferred taking part through a more exposing communication medium such as audio conferencing, while introverts and emotionally stable participants expressed greater readiness to communicate through textual chat. The effect of task characteristic interacted with participant personal traits and type of medium, adding to this trend. In contrast to very low participation and contribution of introverts in face-to-face communication, it seems that asynchronous interactions (Amichai-Hamburger, 2007) as well as synchronous communication through textual chat (Blau & Barak, 2010) empowers introverts by releasing inhibitions of their anxiety of interpersonal interactions ("the poor get richer" phenomenon).

Studies into group dynamics indicate that self-efficacy, or *belief* that one's actions have an effect, seem to motivate sharing in online environments. Participants believed that she or he can "make a difference" contributed to the group regardless of other members' activity (Benbunan-Fich & Koufaris, 2008; Chen, Chen, & Kinshuk, 2009).

Implementing the Model of Network Systems with Google Apps

In order to illustrate how the ideas discussed in this paper could be implemented in companies, organizations or educational institutions, an example of Google Apps is used. There are versions of Google Apps for business, governmental and nonprofit organizations, as well as an educational edition. This system is a cloud workspace whereby, using the same username and password, members can share files, work on projects, collectively author, edit, and review materials, communicate and organize their efforts.

The system is flexible and includes components for different tasks and for different employee or learner needs. Providing commentaries in interactive format through a Blogger application can be recommended to increase dialogue and information exchange both inside and outside the organization. Google Documents allow all the forms of online knowledge exchange: sharing, cooperation, and collaboration of documents, spreadsheets or presentations – across the organization or with specific people. Depending on the task features, editing

Google Documents can be asynchronous and in real-time, supported if necessarily by instant communication. Integrating Google Calendar and/or Task function is recommended for coordination between the participants of collaborative projects. The final version of Google Documents can be published directly on the net or easily embedded in shared or public Google Sites. All versions of the documents are saved and allow exploration of the contribution made by an individual employee or learner. The use of this function of Google Documents is highly recommended for enhancing the willingness to participate and contribute content. In addition, transparency of individual contribution might enhance the willingness of employees or learners to collaborate and co-authoring by diminish the feel of losing a sense of personal ownership or reducing the ownership of others.

Opening worldwide the possibility to edit Google Documents and Sites can help companies receive value in the long tail of power low distribution as well as help CoP and learning communities reach the "critical mass" of content contributors and community involvement. User-generated tags enable the classification of documents and correspondence; internal find function allows easy retrieve of participant contribution. For tracking silent participation (lurking) in Site pages monitoring by administrators through Google Analytics application is recommended.

During the collaboration process, it is important that employees or learners choose an appropriate form of communication. According to the characteristics of the task and personal traits, participants can choose asynchronous communication (interpersonal interaction via email or group discussion through Google Groups application) as well as synchronous interactions based on textual chat, voice, and video interpersonal or group communication. Asynchronous communication is recommended for discussions and reflection. Textual chat is embedded in Google email and documents, providing instant support for group members working on collaborative outcomes. Google Talk opens the possibility for audio and video conferencing, avoiding negative consequences, such as a decrease in communication fluency and an increase in communication ambiguity, when knowledge exchange is attempted. Leaders may recommend to employees or learners avoiding these negative effects of oral speech absence by communicating through audio and video conferencing during short-term collaborative tasks and brainstorming.

CONCLUSIONS AND IMPLICATIONS

Network systems based on technologies and architectures of participation offer a new model of online knowledge sharing, cooperation, and collaboration, that are different from the traditional institutional framework. This model opens new horizons for both companies and non-profit organizations. Developing an e-networked business model, companies can make as much or even more money in the long tail of power low distribution than they were making on the head of the curve in the traditional business model. Opening to everyone the possibility of participating and contributing content, non-profit organization and online communities, including CoP and online learning communities, can ensure reaching the "critical mass" of contributors and involvement level that will keep these communities active. However, in both institutional e-collaboration and e-learning projects with non-mandatory participation it is unrealistic to expect more or less equal content contribution among the participants described as a goal in the literature. It seems that small online groups have a more homogeneous contribution compared to the large networks, but it is still an extremely skewed distribution of activity, very different from the equal participation and content contribution.

Using the trend of pushing the knowledge exchange into the infrastructure it is important to choose flexible technological platforms that supports groups working and learning online on tasks involving the processes of knowledge sharing, cooperation, and collaboration. Similarly, it is important to choose flexible communication technology that opens the possibilities for syn-

chronous and asynchronous group interactions, video, audio, and textual communication-depending on participant personal traits and task characteristics. In addition, practitioners should consider the potential negative effects of e-collaboration accompanied by interactions through communication channels not supporting oral speech.

In future investigations it would be interesting not only on to explore different positive aspects of online communities of practice and open-source development projects, but also to investigate companies adapting the e-networked business model and making profit on the long tail of power low distribution, as well as the new downsides of a networked society as mentioned above. Additional empirical testing of analytical models, such as Pennock et al. (2002), that are able to fit low power distributions and explain their causes, are needed. In such investigations, it would be interesting to explore the influence of different platforms and user interests / company goals on the distribution of member / employee activity and content contribution in the community or company.

REFERENCES

Adar, E., & Huberman, B. A. (2000). Free riding on Gnutella. *First Monday*, 5.

Amichai-Hamburger, Y. (2007). Personality, individual differences and Internet use . In Joinson, A., McKenna, K. Y. A., Postmes, T., & Reips, U. D. (Eds.), *Oxford handbook of Internet psychology* (pp. 187–204). Oxford, UK: Oxford University Press.

Anderson, C. (2008). *The long tail: The future of business is selling more of less*. New York, NY: Hyperion.

Ardichvili, A., Page, V., & Wentling, T. (2003). Motivation and barriers to participation in virtual knowledge-sharing communities of practice. *Journal of Knowledge Management*, *7*(1), 64–77. doi:10.1108/13673270310463626

Baron, R. A., & Markman, G. D. (2000). Beyond social capital: How social skills can enhance entrepreneurs' success. *The Academy of Management Executive*, *14*(1), 106–116. doi:10.5465/AME.2000.2909843

Benbunan-Fich, R., & Koufaris, M. (2008). Motivations and contribution behaviour in social bookmarking systems: An empirical investigation. *Electronic Markets*, *18*(2), 150–160. doi:10.1080/10196780802044933

Blau, I., & Barak, A. (2009). Synchronous online discussion: Participation in a group audio conferencing and textual chat as affected by communicator's personality characteristics and discussion topics. In *Proceedings of the International Conference on Computer Supported Education*, Lisbon, Portugal (pp. 19-24).

Blau, I., & Barak, A. (2010, October). *Synchronous online participation: The effects of participant's personality and discussion topic on participation in face-to-face versus voice chat, and textual group discussions*. Paper presented at the 11th Annual Conference of the Association of Internet Researchers: Sustainability, Participation, Action, Gothenburg, Sweden.

Blau, I., & Caspi, A. (2009). Sharing and collaborating with Google Docs: The influence of psychological ownership, responsibility, and student's attitudes on outcome quality. In *Proceedings of the E-Learn World Conference on E-Learning in Corporate, Government, Healthcare, & Higher Education*, Vancouver, BC, Canada (pp. 3329-3335).

Blau, I., Zuckerman, O., & Monroy-Hernández, A. (2009). Children participation in media content creation community: Israelis learners in Scratch programming environment. In Y. Eshet-Alkalai, A. Caspi, S. Eden, N. Geri, & Y. Yair (Eds.), *Learning in the technological era* (pp.65-72). Ra'anana, Israel: Open University of Israel.

Bouras, C., Giannaka, E., & Tsiatsos, T. (2009). E-collaboration concepts, systems, and applications . In Kock, N. (Ed.), *E-collaboration: Concepts, methodologies, tools, and applications* (pp. 8–16). Hershey, PA: IGI Global. doi:10.4018/978-1-60566-652-5.ch002

Burke, M., Marlow, C., & Lento, T. (2009). Feed me: Motivating newcomer contribution in social network sites. In *Proceedings of the 27th International Conference of Human Factors in Computing Systems* (pp. 945-954).

Caspi, A., & Blau, I. (in press). Collaboration and psychological ownership: How does the tension between the two influence perceived learning? *Social Psychology of Education: An International Journal*.

Chen, I. Y. L., & Chen, N. S., & Kinshuk. (2009). Examining the factors influencing participants' knowledge sharing behavior in virtual learning communities. *Journal of Educational Technology & Society*, *12*(1), 134–148.

Chen, N.-S., & Tsai, C.-C. (2009). Knowledge infrastructure of the future. *Journal of Educational Technology & Society*, *12*(1), 1–4.

Cheng, X., Dale, C., & Liu, J. (2008). Statistics and social network of YouTube videos. In *Proceedings of the 16th International Workshop on Quality of Service*, Enschede, The Netherlands (pp. 229-238).

Ciffolilli, A. (2003). Phantom authority, self-selective recruitment and retention of members in virtual communities: The case of Wikipedia. *First Monday*, 8.

Coiro, J., Knobel, M., Lankshear, C., & Leu, D. (Eds.). (2008). *The handbook of research on new literacies*. Mahwah, NJ: Lawrence Erlbaum.

Coleman, D., & Levine, S. (2008). *Collaboration 2.0: Technology and best practices for successful collaboration in a Web 2.0 world*. Silicon Valley, CA: Happy About Info.

Conner, N. (2008). *Google Apps: The missing manual*. Sebastopol, CA: O'Reilly Media.

Deepwell, F., & King, V. (2009). E-research collaboration, conflict and compromise . In Salmons, J., & Wilson, L. (Eds.), *Handbook of research on electronic collaboration and organizational synergy* (pp. 1–15). Hershey, PA: IGI Global.

Fichter, D. (2005). The many forms of e-collaboration: Blogs, wikis, portals, groupware, discussion boards, and instant messaging. *Online, 29*(5).

Hansen, M. T. (1999). The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits. *Administrative Science Quarterly*, *44*(1), 82–111. doi:10.2307/2667032

Hansen, M. T. (2009). When internal collaboration is bad for your company. *Harvard Business Review*, *87*(4), 82–88.

Ingram, A. L., & Hathorn, L. G. (2004). Methods for analyzing collaboration in online communications . In Roberts, T. S. (Ed.), *Online collaborative learning: Theory and practice* (pp. 215–241). Hershey, PA: IGI Global.

Ingram, A. L., & Hathorn, L. G. (2009). Collaboration in online communications . In Howard, C., Boettcher, J., Justice, L., Schenk, K., Berg, G., & Rogers, P. (Eds.), *Encyclopedia of distance learning* (2nd ed., *Vol. 1*, pp. 314–318). Hershey, PA: IGI Global. doi:10.4018/978-1-60566-198-8.ch045

Ireson, N., & Burel, G. (2010). Knowledge sharing in e-collaboration. In M. A. Wimmer, J.-L. Chappelet, M. Janssen, & H. J. Scholl (Eds.), *Proceedings of the 9th IFIP WG 8.5 International Conference on Electronic Government* (LNCS 6228, pp. 351-362).

Jenkins, H. (2006a). *Confronting the challenges of participatory culture*. Chicago, IL: MacArthur Foundation.

Jenkins, H. (2006b). *Convergence culture: Where old and new media collide*. New York, NY: NYU Press.

Joyce, E., & Kraut, R. E. (2006). Predicting continued participation in newsgroups. *Journal of Computer-Mediated Communication*, *11*(3), 723–747. doi:10.1111/j.1083-6101.2006.00033.x

Kock, N. (2010). Costly traits and e-collaboration: The importance of oral speech in electronic knowledge communication . In Kock, N. (Ed.), *Evolutionary psychology and information systems research: A new approach to studying the effects of modern technologies on human behavior* (pp. 289–303). New York, NY: Springer.

Kock, N., Davison, R., Ocker, R., & Wazlawick, R. (2001). E-collaboration: A look at past research and future challenges. *Journal of System Information Technology*, *5*(1), 1–9. doi:10.1108/13287260180001059

Kock, N., & Nosek, J. (2005). Expanding the boundaries of e-collaboration. *IEEE Transactions on Professional Communication*, *48*(1), 1–9. doi:10.1109/TPC.2004.843272

Lesser, E. L., & Storck, J. (2001). Communities of practice and organizational performance. *IBM Systems Journal*, *40*(4), 831–841. doi:10.1147/sj.404.0831

McInnerney, J., & Robert, T. S. (2004). Collaborative or cooperative learning? In Roberts, T. S. (Ed.), *Online collaborative learning: Theory and practice* (pp. 203–214). Hershey, PA: IGI Global.

Nelson, R. (2008). *Learning and working in the collaborative age: A new model for the workplace*. Video of presentation at the Apple Education Leadership Summit, San Francisco, CA.

Palmisano, J. (2008). A motivational model of knowledge sharing . In Burstein, F., & Holsapple, C. W. (Eds.), *Handbook on decision support systems* (*Vol. 1*, pp. 355–370). Berlin, Germany: Springer-Verlag. doi:10.1007/978-3-540-48713-5_18

Peddibhotla, N. B., & Subramani, M. R. (2007). Contributing to public document repositories: A critical mass theory perspective. *Organization Studies*, *28*(3), 327–346. doi:10.1177/0170840607076002

Pennock, D. M., Flake, G. W., Lawrence, S., Glover, E. J., & Giles, C. L. (2002). Winners don't take all: Characterizing the competition for links on the web. *Proceedings of the National Academy of Sciences of the United States of America*, *99*(8), 5207–5211. doi:10.1073/pnas.032085699

Pierce, J. L., Kostova, T., & Dirks, K. T. (2003). The state of psychological ownership: Integrating and extending a century of research. *Review of General Psychology*, *7*(1), 84–107. doi:10.1037/1089-2680.7.1.84

Raban, D. R., & Rafaeli, S. (2007). Investigating ownership and the willingness to share information online. *Computers in Human Behavior*, *23*(5), 2367–2382. doi:10.1016/j.chb.2006.03.013

Rafaeli, S., & Ariel, Y. (2008). Online motivational factors: Incentives for participation and contribution in Wikipedia . In Barak, A. (Ed.), *Psychological aspects of cyberspace: Theory, research, applications* (pp. 243–267). Cambridge, UK: Cambridge University Press.

Rafaeli, S., Hayat, T., & Ariel, Y. (2009). Knowledge building and motivations in Wikipedia: Participation as "Ba" . In Ricardo, F. J. (Ed.), *Cyberculture and new media* (pp. 52–69). New York, NY: Rodopi.

Ravid, G. (2007, August). *Open large shared knowledge construction systems' dominance: The Wikipedia social structure.* Paper presented at the Academy of Management Annual Meeting, Philadelphia, PA.

Ravid, G., Kalman, Y. M., & Rafaeli, S. (2008). Wikibooks in higher education: Empowerment through online distributed collaboration. *Computers in Human Behavior*, *24*(5), 1913–1928. doi:10.1016/j.chb.2008.02.010

Roschelle, J., & Teasley, S. (1995). The construction of shared knowledge in collaborative problem solving . In O'Malley, C. E. (Ed.), *Computer supported collaborative learning* (pp. 69–97). Heidelberg, Germany: Springer-Verlag.

Rubin, A. M. (1994). Media uses and effects: A uses-and-gratifications perspective. J. Bryant & D. Zillmann (Eds.), *Media effects: Advances in theory and research* (pp. 417-436). Mahwah, NJ: Lawrence Erlbaum.

Schoberth, T., Heinzl, A., & Rafaeli, S. (2011). *Quantifying the skewed distribution of activity in virtual communities within a longitudinal study.* Retrieved from http://wifo1.bwl.uni-mannheim.de/fileadmin/files/publications/Working%20Paper%203_2009.pdf

Shirky, C. (2009). *Here comes everybody: The power of organizing without organizations*. New York, NY: Penguin Press.

Stafford, T., Stafford, M., & Schkade, L. (2004). Determining uses and gratifications for the Internet. *Decision Sciences Atlanta*, *35*(2), 259–288. doi:10.1111/j.00117315.2004.02524.x

Surowiecki, J. (2004). *The wisdom of crowds: Why the many are smarter than the few and how collective wisdom shapes business, economies, societies, and nations*. New York, NY: Doubleday.

Tapscott, D., & Williams, A. D. (2007). *Wikinomics: How mass collaboration changes everything*. New York, NY: Portfolio.

Ulieru, M., & Verdon, J. (2008). IT revolutions in the industry: From the command economy to the e-networked industrial ecosystem. In *Proceedings of the 6th IEEE International Conference of Industrial Informatics*, Daejoen, Korea (pp. 1315-1320).

Ulieru, M., & Verdon, J. (2009). Organizational transformation in the digital economy. In *Proceedings of the 7th IEEE International Conference of Industrial Informatics*, Cardiff, Wales (pp. 17-24).

van den Hooff, B., & de Ridder, J. A. (2004). Knowledge sharing in context: The influence of organizational commitment, communication climate, and CMC use on knowledge sharing. *Journal of Knowledge Management*, *8*(6), 117–130. doi:10.1108/13673270410567675

Vitvar, T., Peristeras, V., & Tarabanis, K. (Eds.). (2010). *Semantic technologies for e-government*. Berlin, Germany: Springer-Verlag. doi:10.1007/978-3-642-03507-4

Weinberger, D. (2007). *Everything is miscellaneous: The power of the new digital disorder*. New York, NY: Times Books.

Zuckerman, O., Blau, I., & Monroy-Hernández, A. (2009). Children's participation patterns in online communities: An analysis of Israeli learners in the Scratch online community. *Interdisciplinary Journal of E-Learning and Learning Objects*, *5*(1), 263–274.

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Towards an Affordance-Based Theory of Collaborative Action (CoAct)

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ABSTRACT

Collaborative Action provides a novel approach to modeling interaction among users and machines and IT-mediated collaboration among people to solve problems. CoAct extends the notions of affordance and moves away from idiosyncratic, subjective mental models of the world to the notion that actors with similar capacities to act can potentially discern similar action possibilities in the world. It changes the direction from discovery and alignment of internal representations to mutual attunement of collaborators to build sufficient capabilities, share informational structures, and calibrate selectivity to achieve shared affordances. CoAct has the potential to influence such diverse areas as usability engineering, information overload, and group decision making. CoAct can be used at multiple levels of granularity, from fine granularity of a single interaction to tracking intermediate progress and results of a set of interactions. Propositions based on CoAct are presented. An initial experiment provides some support for an affordance-based approach to information sharing/design.

Keywords: *Affordance, Collaborative Action, Ecological Psychology, Group Decision-Making, Information Sharing, Interface Design, Internal Representations, Mental Models, Usability Engineering*

INTRODUCTION

In complex environments, where not all variables and relationships are known, i.e., where data are uncertain and incomplete, humans create rather than discover their future (Nosek, 2005). They create the future by perceiving affordances within their environment and acting. The subsequent actions, including probing of the environment, lead to changes in the environment that must provide meaningful affordances for other actors, both human and non-human. These behaviors can be immediately perceived by other actors or they can modify the environment, such as the creation of a report, to provide affordances at some later time. Human and non-human actors must be attuned to relevant affordances, to act based on them, and to probe for additional relevant affordances. The more important the action, the more dynamic, equivocal the task, the more unreliable the data, the more important group sensemaking (Gephart, 1993; Weick, 1979) to the emergence of socially-constructed capacities to act, sufficiently coordinated to engender effective action (Nosek, 2005).

The Theory of Collaboration Action (CoAct) has grown out of the desire to provide

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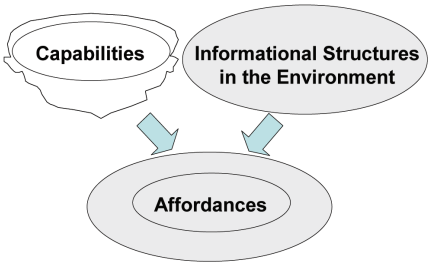
more theory-based direction in information system development, especially in development of collaboration technology to enable creative solutions to wicked problems (Farooq, Carroll, & Ganoe, 2008). Relying on the assumption of the existence of idiosyncratic, intermediary internal representations, such as mental models, to filter sense-data limits practical, theory-based guidance. Extending this assumption so that collaboration technology must support the creation and maintenance of shared mental models within teams exacerbates the problem. "This all-absorbing concern for the internal, mental model unfortunately led to a neglect of other aspects, of which the most important was the flexibility and variability of human performance (Hollnagel & Woods, 2005, p. 41)." Hollnagel and Woods question derivative folk models, which are based on consensus and "privileged knowledge' about how the mind works (Morick in Hollnagel & Woods, 2005, p. 51)." Examples of folk models include fatigue; workload (Stassen, Johannsen & Moray, 1990) and situation awareness (Endsley, 1995, 2001). Many folk models purport to measure intervening variables representing intermediate mental states rather than performance. Folk models may not be incorrect but are hard to disprove, i.e., they are not falsifiable. Others (Bloor, 1983; Brand, 1979; Heft, 2001; Wilson, 1998) have argued that there are no intermediary internal representations, i.e., no "proverbial little men in the mind," such as mental models (Cannon-Bowers, Sala, & Converse, 1993; Gentner & Stevens, 1983; Johnson-Laird, 1983), beliefs, cognitive constructs (Adams-Webber, 1979; Fransella & Bannister, 1977), or scripts that are invoked to take-in sensory information and process it. They argue that there is no mind/body dichotomy (Heft, 2001). This view is supported by recent findings in brain research (Yufik & Georgopoulos, 2002).

The purpose of this paper is not to disparage folk models, but to introduce a theory of collaborative action that does not rely on sharing internal, mental models and extend Gibson's ecological theory of affordance to provide guidance in understanding collaborative acts and developing technology that supports them. The paper provides the following: background for the development of an affordance-based theory of collaboration; explication of Individual Action (IAct) and Collaborative Action (CoAct) Models; propositions and research questions based on these models; results of an initial experiment to test some of these propositions and research questions; followed by examples of how CoAct can be used in design of information systems.

BACKGROUND FOR AFFORDANCE-BASED THEORIES

As actors move within an environment, they discern available informational structures that afford action possibilities. These action possibilities, affordances, are available for the class of actors who have the same potential to discern informational structures that provide these affordances from the same observation point (Gibson, 1979). While an affordance is potentially available for the class of actors with certain capabilities, a perceived affordance is what emerges or surfaces for a given member of the class at a specific moment in time as the member moves through the environment to achieve some goal, i.e., while affordances are available to all actors with similar capabilities and can be defined statically, perceived affordances are a subset of available affordances that emerge dynamically based on what the actor is engaged in at the time and what the goal of the actor is. Also, actors can perceive affordances, but not be self-aware of this perception. The critical difference between available affordances and perceived affordances is often overlooked and may be the cause of some confusion. This may stem from researchers who have been introduced to Gibson's work on affordances through Norman and Draper's (1986) work in design of Human-computer Interaction. Affordances, as used in human interface design, are usually inferred to be available to all humans and not dependent on individual differences. Norman is

Figure 1. Affordances = intersection of actor capabilities and the environment



associated with the idea that interfaces should be "user friendly," i.e., so clear that they intuitively afford any human user what to do with the interface at any time.

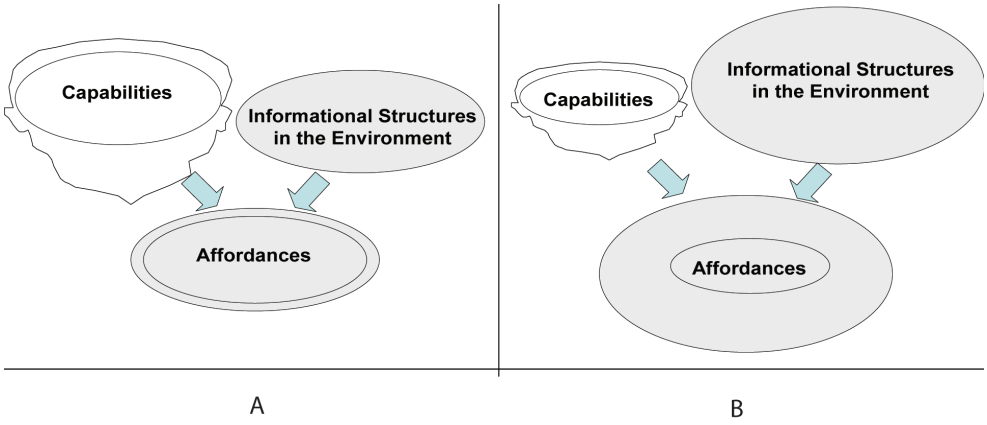
However, affordances only make sense when actor capabilities are coupled with available informational structures within an environment, i.e., actor and environment are inexorably linked and affordances exist at the intersection of actor capabilities and the environment (Gibson, 1979) (Figure 1).

For a given environment, a change in an actor's capabilities can change available action possibilities within the environment (affordances). Figure 2a depicts an example where actor capabilities increase and the environment remains the same as in Figure 1. Available affordances increase for the actor to most of what actions can be available in this environment. Similarly, for a given class of actors, a change in the environment can change the available action possibilities (affordances). Figure 2b depicts one example where actor capabilities remain the same as in Figure 1, but where the environment increases in informational structures. In this case, available action possibilities remain the same as in Figure 1, but the available action possibilities (affordances) are less than what may be available for an actor with greater capabilities. In another example not depicted, the environment could change by increasing equivocality of the informational structures and the existing capabilities of actors are such that available action possibilities (affordances) are reduced. What this also means is that with respect to affordances, actors can be a member of some classes but not others. It means that actors can join classes and may leave classes based on their changes in capacities to act, for example, they may learn, but then forget certain knowledge, or develop, then lose physical abilities. It also means that actors within the same class do not necessarily share all the same capabilities; they only need to share the same capabilities necessary to pick up informational structures that reveal affordances for those in the class.

As noted previously, perceived affordances are a subset of available affordances that emerge/surface as an actor moves through the environment to achieve some goal or assuage some need. Figure 3 depicts how perceived affordances are dynamic and change over time given the goal and current activity. For simplicity, in Figure 3 the informational structures within the environment and actor capabilities remain the same through time, which means that the set of affordances remain the same for actors in the class with these capabilities, while what is perceived within this set changes over time.

For example, a doorknob in its normal position on a door may afford graspability for the class of average humans, but not for a class of one-foot-tall, blind actors with no limbs. This doorknob may be in a room where there are chairs that afford sitability, pens that afford writability, etc. (the set of affordances that are defined at the intersection of an average human actor within this given environment). However, a given actor of the class of average humans may only perceive the doorknob's graspability when the member is confronted with a closed

Figure 2. a. Changed Capabilities (increased) b. Changed Environment (increased)



door as he is attempting to enter or exit a space. As noted previously, it is important to remember that perception does not mean that the actor is self-aware of the doorknob's graspability.

Extending Gibson's Affordance-Based Theory Beyond The Physical

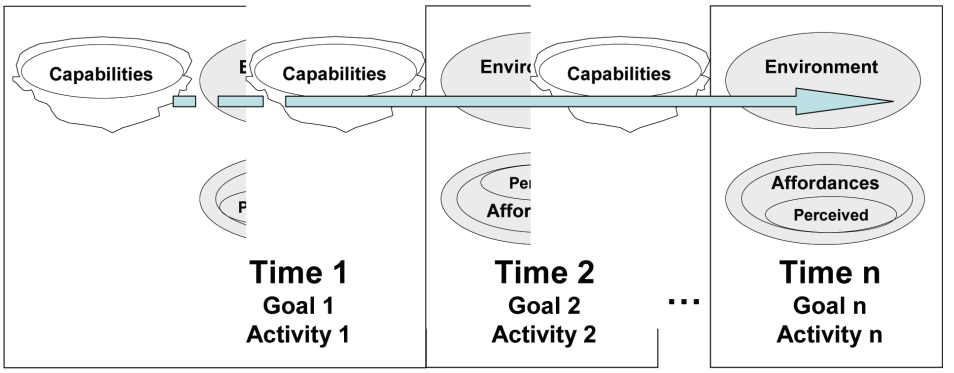
While Gibson (1979) focused on affordances that are discernable to a class of actors with certain physical capabilities to act, CoAct extends the notion of capacities/capabilities to include more than just physical attributes. This is consistent with Gibson's view of the potentially broad applicability of his theory. Capacities to act can broadly include capacities to do, think, feel, etc. For example, informational structures in the environment may afford sadness or happiness for one class of actors with certain capabilities, but not another. In addition, the idea of an actor moving through an environment is not restricted to the physical movement of the actor within a physical environment, but includes the notion that actors are active with respect to what informational structures they pick up, i.e., the notion of static is the exception. Moving through the environment can mean the working through a problem, the reading of a book, the engagement in a discussion. The importance of the concept of moving through the environment means that one is continually experiencing one's environment and is forever changed by this experience, i.e., "cognitively rewired" (Pizlo, 2007). Even visual perception to recognize objects in the environment appears to be dependent on prior experience and/or genetic encoding (Pizlo, 2001, 2007). "Cognitive systems do not passively react to events; they rather actively look for information and their actions are determined by purposes and intentions as well as externally available information and events (Hollnagel & Woods, 2005, p. 16)."

Reinterpreting Existing Research from an Affordance-Based Perspective

As noted earlier, the purpose of this paper is to provide an alternate view of collaborative action that does not rely on hidden, internal representations, such as, mental models, and not necessarily to dismiss previous non affordance-based work. There are constructs from non affordance-based theories that can be useful when reinterpreted from an affordance-based perspective.

Osgood (1969), in his Theory of Meaning, attempted to identify the objective meanings of words. Coincidentally, Osgood started publishing this work about the time of the death of Wittgenstein, a philosopher whose earlier philosophy would be in complete agreement

Figure 3. Perceived Affordances = Subset of Affordances based on Goal and Current Activity over Time



with Osgood's, but who rejected this objective reality in his later philosophy where he passionately proselytized that the meaning of words can only be ascertained through their use. However, Osgood's contribution is that he could explain about 50% of the variability in the meaning of words. Of the 50% he could explain, most of it could be explained as (1) judgment (70%), followed by (2) potency, how great or small, and (3) action (direction), moving in one direction or another. For example, something is bad (judgment), very bad (potency), and getting worse (action/direction).

Applying Osgood's Theory of Meaning to Gibson's Ecological Theory of Affordance, one can see the correspondence, in that some affordances can be described as a judgment (inference) of a certain potency and direction. However, Gibson and Wittgenstein would say that an actor is not necessarily self-aware of the judgment, potency and direction in acting on available affordances with these properties.

One conceives rather than perceives of a thing having a property (Brand, 1979). It would be consistent with Wittgenstein to say that an actor can perceive and then act without self-awareness (Bloor, 1983; Boland & Tenkasi, 1995). Self-reflection (conception) may cause the actor to project onto the available informational structures the judgment that these informational structures afford some action opportunities, but self-awareness is not necessary for perception to occur. In fact, perception, and not conception, is the norm and only through self-reflection by the actor or observation of the actor's action could one ascertain the affordance that was perceived. For example, in the previous example with the doorknob, only upon self-reflection by the actor or observation of the actor grasping the doorknob as he was leaving could one ascertain that the doorknob's affordance of graspability was perceived.

Kelly's Cognitive Construct Theory proposes that each individual uses a limited, personal set of "cognitive" constructs to make sense of a situation (Adams-Webber, 1979). Although Kelly did not use the term judgment, it appears that these so-called cognitive constructs are actually elicited judgments that individuals project onto the situation when queried about it. These judgments have bi-polar values, e.g., jumpability only makes sense with respect to the opposite pole of non-jumpability. This projection of a judgment onto a situation when queried is similar to the use of self-reflection to project onto available informational structures the judgment that they afford action possibilities.

The value of Osgood's and Kelly's work to affordance-based theories comes from the fact that self-reflection on informational structures provided to actors, elicits a judgment, and this is similar to what occurs in self-reflection by

actors, or observation of actors, acting on available affordances. Osgood also provides useful dimensions of potency and direction. For actors with sufficient capabilities, informational structures afford action opportunities, of a certain potency and direction.

What this affordance-based reinterpretation of Osgood's and Kelly's work points out, and which may apply to much of folk theories that purport to have "privileged knowledge" about the internal workings of the mind, is that self-reflection is the less-frequent way that one acts. When one is self-reflecting, perception of action possibilities within externally available informational structures (perceived affordances) declines. One interpretation may be that self-reflection causes something like "conceived affordances" to emerge within internally available informational structures in a similar way the subset of perceived affordances emerge from the set of affordances available in external informational structures for actors with similar capabilities. The problem occurs when proponents of folk theories interpret these elicited "conceived affordances" as internal representations, such as cognitive constructs or mental models that "process" stimuli. To further clarify, these "conceived affordances" are a result or snapshot of the intersection of existing actor capabilities and informational structures that become available upon reflection, i.e., the actor projects onto an elicited, self-reflection at a given moment of time these "conceived affordances." Conceived affordances are not the cognitive constructs or mental models that actors use to process information.

In fact, because much of folk-theory research on internal representations demands actors to reflect and project meaning onto these reflections, their results may still be valid, but not their interpretation, i.e., not why the researchers think. These projections of "conceived affordances" may be used to align other actors so that the projections of collaborating actors elicit similar "conceived affordances." However, what is occurring is not the alignment of internal representations, such as cognitive constructs and mental models, but the building of sufficient, similar capacities in actors, sharing informational structures, and calibrating selectivity of relevant informational structures at the appropriate time.

One may interpret the above arguments as "no big deal." Ecological psychologists use affordances to explain phenomena and cognitive psychologists use such things as mental models and cognitive constructs. However, affordance-based interpretations do not rely on knowing and sharing internal representations. Conceptualizing phenomena from an affordance-based perspective may expand current boundaries that exist (Kock & Nosek, 2005) when restricted to consensus-based, folk theories that purport to have "privileged knowledge" about the internal workings of the mind. The following section explores affordance-based models and theories.

AFFORDANCE-BASED MODELS

We first model an affordance-based theory of individual action (IAct). This model will then be expanded to include actors in collaborative action (CoAct).

Individual Action (IAct)

Referring to Figure 4, as an actor with a certain capacity to act (Gibson, 1979; Heft, 2001) actively engages within his environment (current activity) (Gibson, 1979; Heft, 2001) for some purpose (achieve goal or fulfill need) (Heft, 2001), the actor actively selects from available informational structures that afford action opportunities (affordances) (Gibson, 1979; Heft, 2001; Osgood, 1969). Behavior includes intended and unintended, explicit and implied, verbal and non-verbal. Behavior of the actor becomes part of the informational structures available within the environment "insofar as they are tangible, audible, odorous, tastable, or visible" (Gibson, 1979, p. 135). This behavior may also provide informational structures to observers as to affordances perceived by the actor. As noted previously, self-reflection or

observation of behavior may indicate what affordances were perceived by the actor.

Collaborative Action Theory (CoAct)

In this section, IAcT is expanded to build a model of Collaborative Action (CoAct). CoAct can be used at multiple levels of granularity, from fine granularity of understanding a single interaction, to tracking intermediate progress and final results of interactions. For effective collaborative action, actors, whether human or non-human, must perceive shared, relevant affordances at the appropriate time (Figure 5). A shared affordance is an affordance that is shared by more than one actor. To achieve a shared, perceived affordance: 1. the actors must share sufficient capabilities so that a given environment affords the same action opportunity for the actors; and 2. this affordance or action opportunity is available (or perceived) at the appropriate time, i.e., an affordance that is available to an actor, but is not perceived when it is suppose to be, is not considered a shared, perceived affordance. A shared, perceived affordance may occur at the same time among actors, but it may also occur asynchronously, as long as this is considered an appropriate time to support collaborative action.

The process to achieve and the end-state of achieving shared, perceived affordances use the same label, "attunement." Attunement means "being or bringing into harmony; a feeling of being "at one" with another" (Dictionary.com's 21st Century Lexicon). For example, one can say that collaborators attune each other, i.e., undergo mutually attunement (bringing into harmony) to achieve attunement (being in harmony) of perceiving shared relevant affordances at the appropriate time. Context determines which form of the word is meant.

Actors engaged in collaborative action must take responsibility for mutual attunement by 1. sharing relevant informational structures, 2. bringing each other up to the sufficient capabilities of the class of actors for whom the environment affords the desired, relevant action opportunities (affordances), and 3. assisting each other in perceiving the subset of relevant affordances at the appropriate time (Selectivity Calibration).

In Figure 5, we identify the actor who is actively attuning as the Source Actor, and the actor who is the target of this attunement effort as the Target Actor. However, as noted previously, these roles alternate as collaborators engage in mutual attunement. Initially, at Time 1, the actors do not share the relevant informational structures within the environment and sufficient capabilities. Therefore, they cannot perceive relevant affordances. This is depicted by the actor at the bottom (the Target Actor) only sharing half of what the actor on the top (Source Actor) has available.

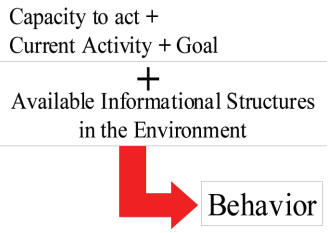
In Time 2, the Source Actor attunes the Target Actor by sharing relevant informational structures in the environment, assisting the Target Actor to achieve sufficient capabilities (this is shown by the capabilities of the Target Actor are now the same as the Source Actor), and assisting the Target Actor in perceiving relevant informational structures at the appropriate time (Selectivity Calibration). At the end of Time 2, both actors perceive similar, relevant affordances. For simplicity sake, although we only depict one Target Actor in Figure 5, there could be more than one Target Actor in a given collaborative act.

In Gibsonian terms, actors attune each other to perceive relevant affordances by building sufficient capabilities in each other, exchanging informational structures so they are available to both, and bringing each other to a common observation point within the environment of available informational structures at the appropriate time (Figure 6).

Examples of Achieving Shared Affordance

The following examples use the shared affordance of stream-jumpability. Consider the scenario where actors are running for their lives when they come upon a stream, although not necessarily at the same time. For simplicity, only

Figure 4. Individual Action (IAct)



two actors are presented, however, in actuality there could be more than two.

Example with No Self-Reflection and No Conscious Attunement

1. Actor 1 jumps the stream. Actor 1 perceived the jumpability of the stream (perceived affordance) from the available informational structures. He may have further perceived that the stream was very jumpable (potency), and increasingly jumpable (direction), i.e., increasing strength of the affordance due to the immediate threat, but there is no way to know.
2. Actor 2 observes Actor 1's jumping of the stream which attunes Actor 2.
3. Actor 2 attempts to jump the stream.

Example with Self-Reflection and Conscious Attunement

1. Actor 1 perceives the stream, but does not jump.
2. Actor 1 becomes self-aware of the perceived stream and conceives the affordance of stream-jumpability, i.e., he reflects on the circumstances and projects onto available informational structures that the stream is jumpable, very jumpable (potency), and increasingly jumpable (direction).
3. Actor 1 consciously attunes Actor 2 so that Actor 2 will share his affordance of stream-jumpability by exposing behavior.
4. Actors 1 and 2 attempt to jump the stream.

Attunement

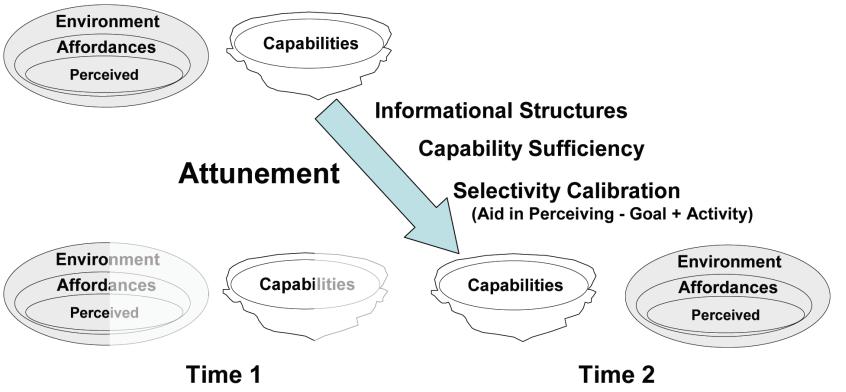
The above examples illustrate the affordance-based notions of attunement, which is both conscious and unconscious, to effect collaborative action among actors. Although the very act of participating in a collaborative act may increase the likelihood of self-awareness; it is also possible that conception (self-awareness) may not occur, as in Example 1.

Attunement can be intended and unintended, explicit and implied, verbal and non-verbal. For example, an actor may explicitly expose his/her identity intending to imply positive informational structures as to status, however, the receiving actor may not treat this datum as positive. As noted earlier, actors attune each other by sharing relevant informational structures in the environment, assisting each other to achieve sufficient capabilities, and assisting each other in perceiving relevant informational structures at the appropriate time. Table 1 summarizes components of attunement. Note, not all components exist in every act of attunement. Attunement related to Selectivity Calibration aligns the goals and activities of actors. As noted earlier, this relates to Gibson's idea that an actor moves within the environment picking up informational structures to achieve some goal and affects what affordances are perceived at a given moment in time.

CoAct

Figure 7 depicts CoAct, an affordance-based model of collaborative acts. As noted earlier, this model can be used at multiple levels of

Figure 5. Attunement to Perceive Shared, Relevant Affordances at the Right Time



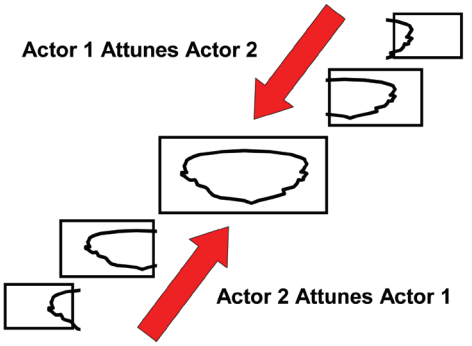
granularity, from fine granularity of understanding a single interaction, to tracking intermediate progress and final results of interactions. In a collaborative act, there can be more than one Target Actor, but the Source Actor should be considered a single entity (Nosek, 2005). As noted earlier, actors interchangeably take on the roles of Source and Target as they attune each other to achieve shared affordances. Overall, the model shows that the Source Actor, with certain capabilities, moves through a given environment and perceives affordances available to actors with those capabilities (upon self-reflection these perceived affordances become conceived affordances). The Source Actor attunes the Target Actor by building sufficient capabilities, sharing relevant informational structures, calibrating selection of relevant informational structures, and exposing affordances (perceived are inferred by the Target Actor and conceived are relayed to the Target Actor). The Attunement Process changes capabilities, available informational structures, and selectivity which results in changes to the Target Actor's affordances.

Factors which affect the Source Actor's attunement of the Target Actor include such things as the Source Actor's knowledge of (Vivacqua & Moreira de Souza, 2008), trust of (Remidez, Stam, & Laffey, 2010), and dependence on (Pick, Romano, & Roxtocki, 2009) the Target Actor. Other variables such as task importance and time constraints can affect the attunement process. These variables should not be considered complete and there may be other variables, not specifically identified in the model, such as collaborative distance (Fallot, Martinez-Carreras, & Prinz, 2010) that affect attunement. Some of these variables affect attunement by affecting the Source Actor's motivation. There are similar factors that affect the effectiveness of the attunement on the Target Actor. Variables such as task importance and time constraints can vary from actor to actor and even from time to time, for example, the Source Actor may view the task as important and urgent, although the Target Actor may not.

One aspect of the model may not be adequately depicted, but deserves special mention. Target Actors may accept the affordances of the Source Actor without being brought up to sufficient capabilities and having shared informational structures so that these affordances are available for Target Actors themselves. For example, Source Actors, who are trusted, may be able to transfer their affordance, but the Target Actors do not have sufficient capabilities so that they can perceive the affordances for themselves. Does this affordance fade easily?

If Source Actors expose their affordances (perceived and conceived) as part of their attunement for a given shared environment, is this a form of learning, i.e., does this teach the Target Actor, either explicitly through conceived affordances transmitted or implicitly through

Figure 6. Gibsonian Mutual Attunement



perceived affordances ascertained through observation, that these and future, similar informational structures afford these action possibilities? Does repetition reinforce building sufficient capabilities? Is learning-by-example a form of this process?

Note, attunement is neither inherently good nor correct and can result in building sufficient capabilities so that Target Actors perceive good, correct affordances or warped, incorrect affordances (Boyle, Kacmar, & George, 2008). For example, Source Actors who enjoy very high trust, such as some fanatical religious leaders, may be able to transfer their affordances of world events in a continuously, warped manner such that Target Actors will perceive affordances within current and future environments that will result in unwarranted and apparently irrational actions, but consistent with CoAct.

Propositions

This section discusses some CoAct propositions. Please refer to Figure 7.

Proposition 1: Relevant exposed behavior will consist of components of attunement. CoAct provides a way to differentiate behavior and predicts the categories of behavior which actors will expose to achieve shared affordances. This proposition does not deal with the quality of the exposed behavior of the actors or the success of achieving shared affordances, but does provide a boundary on what is expected in the behavior exposed to achieve shared affordances.

Proposition 2: Better attunement will lead to more shared affordances. For a given situation, actors who do a better job in attunement should be more successful in achieving shared affordances.

Propositions 3 through 6 relate to the Source Actor's knowledge of the Target Actor. The better this is, then all other things being equal, the better the attunement. If the Source Actor exposes behavior relevant just for his or her class and the Target Actor is not part of this class, then the Source Actor will be less successful in achieving shared affordances. The Target Actor may be from a different class than the Source Actor where attunement is not possible and exposed behavior may focus on achieving shared affordances that are not available to the Target Actor. The Target Actor may not understand or pay attention to such exposed behavior and shared affordances cannot be achieved.

Proposition 3: The better the Source Actor's knowledge of the Target Actor's capabilities, informational structures available to the Target Actor, current activity and goal, etc., the better the attunement.

Proposition 4: The better the Source Actor's knowledge of the Target Actor's capabili-

Table 1. Summary of attunement components

Informational Structures: Relevant aspects of the environment/situation.
Capability Sufficiency Building: Building sufficient, similar capability needed so that affordances needed for collaboration are available to the actors.
Perceived Affordances: Perceived action opportunities in the environment (inferred through observation).
Conceived Affordances: Conceived action opportunities in the environment (explicit through self-aware reflection).
Selectivity Calibration: Assistance in perceiving the relevant affordances at the appropriate time. **Achieve goal or fulfill need** - Align goals; **Current activity** - Align current activity.

ties, the better the attunement in building capability sufficiency.

Corollary 4a: The more the Target Actor shares capabilities with the Source Actor, the less the Source Actor will expose behavior related to building capabilities. If an actor is aware that actors, with whom collaboration must occur, are from the same class, then actors will expect greater shared background. Therefore, less effort will be expended to attune these actors so that they have sufficient shared capabilities to pick up relevant informational structures to achieve shared affordances.

This brings us to **Corollary 4b:** The less the Target Actor shares capabilities with the Source Actor, the more the Source Actor will expose behavior related to achieving sufficient shared capabilities. If an actor is aware that actors, with whom collaboration must occur, are from other classes, then more effort will be expended to attune these actors so that they have sufficient shared capabilities to pick up relevant informational structures to achieve shared affordances.

However, as noted previously, the gap between the Source-Actor and Target-Actor classes may be too high to achieve affordances available to the Source Actor's class. This brings us to **Corollary 4c:** The Source Actor, who is aware that the gap of the Target Actor is too great to achieve shared affordances of the Source Actor's class, will expose behavior to achieve shared affordances at some intersection of the classes.

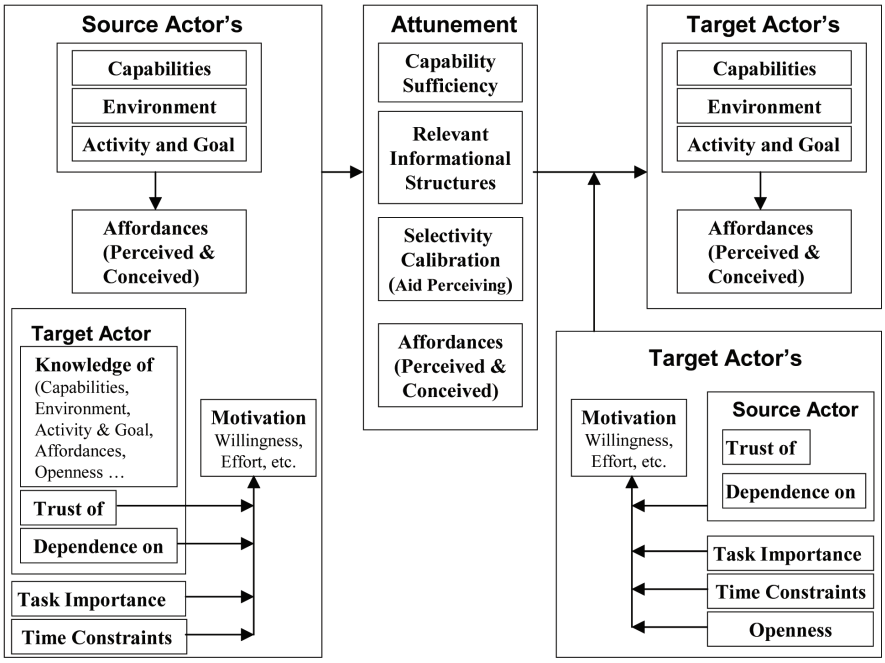
Habermas (1984) offers the concept of lifeworlds to explain the difficulty in achieving shared affordances among actors from different lifeworlds. Borrowing loosely from Habermas, actors of dissimilar backgrounds may be able to find some common elements of lifeworlds that can be shared. Figure 8 provides a schematic of an example of stratifying the shared social world of an individual actor. The unshared subjective world can only be contained within the shared social world. An actor living in the world is part of and helps to create a shared social world.

For example, the Target Actor may be an integral part of the decision making process, but is not experiencing the situation for himself or herself, and may not have the ability to understand the relevancy of facts of the situation at hand. In this case, actors must find a common aspect of a lifeworld to share, for example, the capabilities of actors from the two different classes may intersect on similar cultural or human capabilities to pick up informational structures to share that the situation affords danger. Two examples are offered to illustrate this.

Example 1: Command and Control

In this military situation, a commander on the ground feels threatened, perceives the attackability of the enemy, but must obtain permission to engage from a distant political leader with no military background. In this case, the Source Actor from the class of experienced warfighters must obtain permission from this politician, the Target Actor, who is not within the class

Figure 7. Model of Collaborative Action (CoAct)



of experienced warfighters, and may not be attunable within limited time requirements, to perceive the affordance of attackability of the enemy. However, the Source Actor (warfighter) can then expose behavior that will permit the political decision maker to perceive that the situation affords danger The decision maker at headquarters would then trust the local on-scene commander to make the best decision (including attacking) and implicitly trust the advancement system (shared culture) that puts commanders in this position of responsibility.

Example 2: Medical Emergency Surgery

In emergency exploratory surgery, family members and patients, may share decision-making responsibility with surgeons but do not have the capabilities of the surgeon to pick up informational structures that afford necessary surgery. It may be even more difficult for family members than for patients, who may be experiencing pain, to perceive affordances available to the class of surgeons. Surgeons should, and the best most likely do, focus on selectivity calibration and informational structure sharing to achieve the shared affordance of imminent danger among surgeon, patient and family members. Patients and family members must then trust the surgeon to make the best decision and implicitly trust the medical system (shared culture) that puts surgeons in this position of responsibility.

Proposition 5: The better the Source Actor's knowledge of the Target Actor's Selectivity Calibration (current activity and goal), the better the attunement in Selectivity Calibration. **Corollary 5a:** The more the Target Actor is aligned with the Source Actor's Selectivity Calibration (activity and goal), the less the Source Actor will expose behavior related to Selectivity Calibration. **Corollary 5b:** The less the Target Actor is aligned with the Source Actor's activity and

goal, the more the Source Actor will expose behavior aiding in perception.

Proposition 6: The better the Source Actor's knowledge of the Target Actor's environment, the better the attunement in providing needed, relevant informational structures. **Corollary 6a:** The more the Target Actor shares the Source Actor's environment, the less the Source Actor will expose behavior providing informational structures. **Corollary 6b:** The less the Target Actor shares the Source Actor's environment, the more the Source Actor will expose behavior providing informational structures.

Proposition 7: Perceived affordances will change with changes in Selectivity Calibration. Assuming actor capabilities and informational structures available in the environment remain the same, then changing Selectivity Calibration should change what subset of informational structures are picked up within the environment, i.e., perceived affordances should change.

Proposition 8: For a class of actors, informational structures in the environment can be altered to achieve the desired affordances.

Additional Research Questions

There are several interesting related research questions related to CoAct which may help refine CoAct and which will be addressed.

Research Question 1: In the collaborative act to achieve shared affordance, do some categories of exposed behavior with respect to Selectivity Calibration and informational structures available in the environment provide more informational value than others?

Currently CoAct does not predict what parts of the exposed behavior may be more important than others in achieving shared affordances. This question deals with the efficiency in achieving shared affordances and extending CoAct to incorporate these aspects. In some sense this is a novel extension of the ideas of Shannon and Weaver (1969) when they showed the decreasing informational value of letters in transmitting a word. It may be possible to extend CoAct to provide guidance as to what aspects of exposed behavior to prioritize when transmitting, and/or receiving exposed behavior. It may provide ways to reduce information overload and/or make use of limited bandwidth while still achieving sufficient shared affordances to act effectively. A few responses in the preliminary experiments seem to indicate that perhaps this may be the case. For example, it may be that exposed behavior related to goals provides more informational power than other categories of exposed behavior to more quickly achieve shared affordances. If this is true, then the actor exposing the behavior may choose to transmit this first or only this portion. Likewise, the receiving actor may choose to receive this portion of the exposed behavior first, or only receive this portion.

Research Question 2: Do the perceived characteristics of informational structures change with changes in Selectivity Calibration?

This question relates to how informational structures that do not change in any physical way may be perceived to be different with changes in Selectivity Calibration. For example, let's say an actor is running through the woods for fun and comes upon a stream versus the same actor running through the woods to escape from imminent death and comes upon the same stream that he must cross to survive. Would the actor who is running for fun perceive the same exact stream as being wider and deeper than the actor who is running for his life?

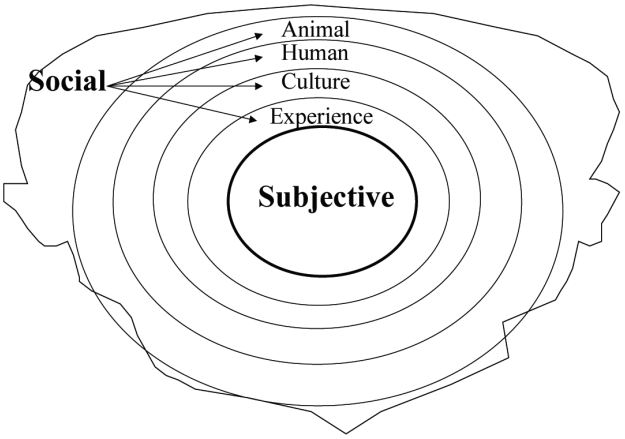
INITIAL EXPERIMENTS

The next sections describe early investigations in testing CoAct.

Operational Hypotheses

The following three null hypotheses were tested. For the first two hypotheses, subjects are not

Figure 8. Stratification of Social and Subjective Worlds



discerning what the environment affords for themselves. Subjects must act as observers of an actor within a scene and indicate what they think the environment affords for the actor.

Hypothesis 1: In trying to achieve shared affordance, the exposed behavior of subjects will not be able to be categorized as Selection Calibration, building capability sufficiency, or informational structure sharing. This hypothesis partially operationalizes Proposition 1. There is a further requirement for this hypothesis in that the subject must describe in words to an assumed other actor, who cannot see the picture, what aspects of the picture this other actor would need to know to describe, in a similar manner as the subject, what the environment affords.

Hypothesis 2: Changing informational structures will not change affordances. This operationalizes Proposition 8. Using CoAcT, different scenes can be constructed to provide different affordances.

Hypothesis 3: Subjects will indicate that the same informational structure, within two different situations that alter Selectivity Calibration (goal and current activity), as being the same. This explores Research Question 2.

Design

The experiment was designed so that subjects from a wide variety of ages and background could participate. It was a web-based, within-group experiment, i.e., one group received Treatment 1 first, followed by Treatment 2, while the other group received Treatment 2 first, followed by Treatment 1.

Pilot Tests

Several pilot tests were conducted to refine the experimental design and the interface. Some of these pilot tests were pen and paper tests and one was a test of the web-based interface that was used in the actual experiment.

Subjects

There were 48 subjects who participated in the web-based test. Subjects were of convenience and were randomly assigned to one of the groups automatically through the web-based system when they began the experiment. The treatments were designed so that participating

human subjects would have sufficient capacities to complete the treatments.

Treatments

There were two treatments that followed a modified general allegory scenario previously used in explicating affordance by ecological researchers (Clancey, 1997). Treatment 1 was a picture of a deer standing near a stream. Treatment 2 was a picture of a running deer heading towards the same-sized stream, followed by a lion. For each treatment, there was the same set of questions. The subject viewed the picture while he or she answered the questions. However, after the question was answered, the subject was not allowed to return to the question. After a subject received the first treatment, there was displayed a screen with no picture and a notification that the experiment would continue with a new treatment. Since the subject could not go back, once a subject started the next treatment, the subject had no access to the picture or questions with the previous treatment. For each picture, subjects were required to

1. Indicate the state afforded by the environment as depicted in the pictures from great safety to great danger;
2. Describe in words to an assumed other actor, who does not see the picture, what aspects of the picture this other actor would need to know to indicate in a similar manner as to what state the environment affords;
3. Indicate the next action that the actor in the picture could take, i.e., what affordance to act is immediately available;
4. Similar to 2 above, describe in words to another actor, who does not see the picture, those aspects of the picture that would have this actor answer in the same way as in 3;
5. Indicate the depth and width of the stream in the picture. (Note: the depth and width of the stream were exactly the same in both pictures and all other aspects of the pictures were of similar scale. As noted earlier, the idea here was to ascertain whether manipulation of the Selectivity Calibration components, goal and current activity (grazing to assuage hunger versus running to escape death), can influence the perception of the depth and width of identical streams).

Results

The evaluation of requirements 2, 3, and 4 is incomplete. The descriptive statistics for questions related to requirements 1 and 5 are presented below in two separate tables. Table 2 is for the group who received Treatment 1, deer standing near a stream, first followed by Treatment 2, deer running towards a stream followed by a lion. Table 3 is for the group who received Treatment 2, followed by Treatment 1. Table 4 presents the results of a One Way ANOVA for two groups. This is similar to a student t-test because there are only two groups, but is considered more powerful. Since there are only two groups, there is no need for post hoc tests.

Discussion

The results of 48 subjects were used in the analysis. With respect to Hypothesis 1, fewer subjects completed these sections with valid answers. Most likely this was because it required more effort and subjects were not adequately motivated. Although a small sample, a few observations can be made:

1. The null hypothesis is rejected. CoAcT provides a valid means to categorize exposed behavior. Content of their descriptions to other actors could be categorized according to CoAcT: Selectivity Calibration (goals, current activity), building capability sufficiency; and sharing relevant informational structures.
2. Although there are not sufficient data points for statistical analysis, several observations can be made with regards to effort to categorize and inter-rater reliability:
   a. It is fairly easy to learn to categorize exposed behavior, however, more

Table 2. Descriptive Statistics: Treatment 1 First

Question	N	Min	Max	Mean	SD
Deer by the stream:					
Q1a: Great danger (1) to great safety (5)	28	1	5	3.25	1.076
Q3a: Very deep (1) to very shallow (5)	23	2	5	3.39	.988
Q3b: Very wide (1) to very narrow (5)	23	2	4	3.43	.843
Running deer followed by a lion:					
Q4a: Great danger (1) to great safety (5)	22	1	5	1.68	1.086
Q6a: Very deep (1) to very shallow (5)	22	2	4	3.55	.739
Q6b: Very wide (1) to very narrow (5)	22	2	4	3.59	.734

Notes: Q1a, Q4a: what the environment affords the deer from great danger (1) to great safety (5);
Q3a, Q6a: The water in the picture is very deep (1) to very shallow (5);
Q3b, Q6b: The water in the picture is very wide to (1) to very narrow (5).

Table 3. Descriptive Statistics: Treatment 2 First

Question	N	Min	Max	Mean	SD
Deer by the stream:					
Q1a: Great danger (1) to great safety (5)	20	2	5	3.90	.912
Q3a: Very deep (1) to very shallow (5)	19	1	5	3.42	1.071
Q3b: Very wide (1) to very narrow (5)	19	2	5	3.26	.933
Running deer followed by a lion:					
Q4a: Great danger (1) to great safety (5)	21	1	5	2.81	1.289
Q6a: Very deep (1) to very shallow (5)	21	2	5	3.67	.856
Q6b: Very wide (1) to very narrow (5)	22	1	5	3.29	1.056

Notes: Q1a, Q4a: what the environment affords the deer from great danger (1) to great safety (5);
Q3a, Q6a: The water in the picture is very deep (1) to very shallow (5);
Q3b, Q6b: The water in the picture is very wide to (1) to very narrow (5).

training will be needed to increase inter-rater reliability;

b. Some behavior is easier to rate than others. For example, Selectivy Calibration, building capability sufficiency and affordances seem to be very clear and there is higher inter-rater reliability, while what constitutes informational structures seems to be less clear.
c. There is a need to develop a process where perhaps a third rater is used when inter-rater reliability is not close enough. If the third rater does not resolve the discrepancy than that portion of the response should not be used.
d. There is a need to develop a protocol to handle words that provide little informational value as to affordance but are used to make sense grammatically.
e. Although not tested, anecdotally raters were able to judge a difference in the quality of descriptions. Those subjects who provided better Selectivity Calibration, capability sufficiency-building behavior and more precise informational structures were judged

to be of higher quality and more likely to achieve shared affordance. Testing of other propositions require evaluation of the quality of the exposed behavior. Metrics to measure quality appears to be achievable.

3. Although subjects were directed to not provide the actual affordance in getting other actors to perceive the same affordance, some found it difficult to provide descriptions without including words that could be considered similar to the affordance they identified.
4. Although not tested, some parts of the descriptions seem to provide more informational value than others. See Research Question 1.

Null Hypothesis 3 is not rejected. There is no statistically significant finding for changes in the perceptions of the width and depth of the river under different treatments; however, there was a small change of means for the subjects who had Treatment 1 first. They perceived that the river was less deep (3.39 versus 3.55) and less wide (3.43 versus 3.59) for Treatment 2 where the deer was running, followed by a lion.

Null Hypothesis 2 is rejected. Without resorting to internal representations, treatments were modified to afford different actions. Subjects perceived that one treatment afforded more danger than another and afforded different physical actions for the actor. This demonstrates that subjects clearly viewed that the environments in Treatments 1 and 2 afforded different actions. In Treatment 1, where the deer is standing by a stream, subjects perceived that the environment afforded the deer the action opportunities to eat, drink, play, or do nothing. However, in Treatment 2, subjects perceived that the environment afforded running (fleeing, escaping) or jumping. This reinforces that changes in the environment, including Selectivity Calibration (in this case goals and current activity), changes available and perceived affordances.

What was also interesting and is deserving of more study is the finding that groups differed in the evaluation of how much danger the environment afforded depending on what treatment they first received. Subjects who received Treatment 1 first, i.e., the picture of the deer by the stream, indicated that this environment afforded less safety as compared to subjects who received Treatment 1 second, i.e., after the treatment with the deer followed by the lion (statistical significance .033). Also, subjects that received Treatment 1 first, found that the environment in Treatment 2 (deer being chased by the lion) afforded more danger as compared to subjects when presented Treatment 2 first (statistical significance .003) It appears that the experience of the first treatment has "cognitively rewired" the subjects (Pizlo, 2005). According to CoAcT, these experiences attuned the subjects, i.e., calibrated the selection of informational structures within the environment so that they now perceive the environment providing more or less safety.

Limitations

Two hypotheses tested the most basic research objectives which were of a binary nature. Does CoAcT provide a means to categorize exposed behavior and can the environment be manipulated to alter affordances? These are important questions, but do not lend themselves to sophisticated statistics. Although these are preliminary experiments with crude experimental materials, they demonstrate that CoAcT can provide a potentially powerful model of collaborative interaction not dependent on eliciting internal representations that filter sense data. However, the major limitation of the study was the inadequate test bed. Comprehensive testing of propositions and research questions demands the development of a more powerful, flexible test bed, capturing better metrics. Testing will require first person scenarios where subjects interact directly with the environment and their success depends on exposing behavior to other collaborators to achieve shared affordance. In addition, subject motivation was an issue. More engaging testing interaction and some minimal reward structure may improve subject motivation.

Table 4. ANOVA Results

Question	Sum of Squares	df	Mean Squares	F	Significance
Q1a BG	4.929	1	4.929	4.819	.033
WG	47.050	46	1.023		
Total	51.979	47			
Q3a BG	.009	1	.009	.009	.926
WG	42.110	40	1.053		
Total	42.119	41			
Q3b BG	.306	1	.306	.391	.535
WG	31.336	40	.783		
Total	31.643	41			
Q4a BG	13.664	1	13.664	9.657	.003
WG	58.011	41	1.415		
Total	71.674	42			
Q6a BG	.158	1	.158	.248	.621
WG	26.121	41	.637		
Total	26.279	42			
Q6b BG	1.001	1	1.001	1.221	.276
WG	33.604	41	.820		
Total	34.605	42			

Note: BG: Between Groups; WG: Within Groups

IMPACT AND APPLICATION OF COACT

There are a number of areas where CoAct can have an impact. A few are described below.

Usability Engineering

Usability Engineering is emerging as a parallel process to software engineering, where software engineering focuses on system functionality and usability engineering focuses on methods and processes to design appropriate system usability (Leventhal & Barnes, 2007). In usability engineering, users are characterized along several dimensions, such as age, gender, nationality, etc. and tasks can be categorized along several dimensions including complexity and frequency of task completion (Leventhal & Barnes, 2007; Rosson & Carroll, 2002). It has been accepted practice to reduce these dimensions by broadly describing users as novice, infrequent knowledgeable, and expert (Leventhal & Barnes, 2008; Rosson & Carroll, 2002). It has also been accepted practice to characterize the artifacts, with which users interact, separately from the user, i.e., it is common to describe an interface as easy-to-use or not easy-to-use without referring to the capabilities of the user. Along with this, there exists the unspoken assumption that more usability is always better. However, providing unnecessary usability may cost more and delay system release.

Humans, using computers to complete their work, progress through a sequence of cycles of interaction steps and information displays, where the last information display provides affordances for the next interaction step (Preece, 1994), as the user takes action to achieve some goal. For each step in the cycle, the usability engineer's design assumes an envisioned user, i.e., the design will provide appropriate affordances at the appropriate time for a user with certain capabilities engaged in an activity to achieve some goal. In a sense this describes a CoAct-valid collaborative act, where effective design must provide that future users will share the same affordances at the appropriate time as the envisioned class of users with sufficient, similar capabilities. The difference between the envisioned user and the

actual user equals design quality and attunement needed, such as training.

In interface development, theoretical analysis is more efficient than empirical testing (Preece, 1994). Iact and CoAct provides the basis for more precise theoretical analysis that can be used in creating and evaluating designs. For example, does the usability engineer's design achieve effectiveness, efficiently? Analysis may indicate what attunement, in the form of training, will be required to bring expected users to the level of the envisioned user. If judged too much, the usability engineer may be able to alter the design to reduce attunement (training) needs. On the other hand, analysis may reveal a simpler, less user-friendly, but adequate, design that is faster and less-costly to develop. This process helps to prioritize features and fits well with agile development processes (Larman & Vodde, 2009).

Reducing Data Overload/More Effective Use of Bandwidth

Data overload, sometimes referred to as information overload, is growing exponentially worse as the amount of data increases. Having some theory related to what data provides more informational value than others or having informational structures become available as one is performing a certain activity in achieving a goal would be enormously helpful. In times of reduced bandwidth, CoAct may provide guidance on what exposed behavior should be transmitted or received.

Improving Group Decision Making

Moving away from shared mental models to shared affordance could help improve decision making. When group decision making involves members of different classes, for example, in politician-directed military action and emergency surgery, then decision processes could move towards finding affordances at the intersection of classes or through the process of attunement to bring actors to a sufficient common capacity to act effectively.

EXAMPLE OF APPLYING COACT TO USABILITY DESIGN

As noted earlier, providing theory-based guidance that does not rely on idiosyncratic, internal representations motivated development of CoAct, an affordance-based theory. This section illustrates the application of CoAct within usability engineering. First, categorization of user capabilities with respect to interface design are discussed, including the concept of multi-level affordances enabled by learning. Next, CoAct is used to evaluate a feature of a common interface.

In usability engineering, it is useful to identify user capabilities with respect to semantic and syntactic knowledge. Semantic knowledge deals with conceptual knowledge, while syntactic knowledge deals with the specific rules. For example, in programming, semantic knowledge of loops would include the understanding of initial value, condition, and increment; syntactic knowledge would be the rules of implementation within a given programming language.

Figure 9 shows a small part of a screen in an actual application to support estimating contracting jobs. There are levels of understanding with the checkbox and accompanying label, "Installation." The lowest level affordance deals with the checkbox and the "checkability" of the box.

The semantic and syntactic knowledge needed for this "lower level affordance" of checkability is as follows:

Semantic knowledge: a checkbox allows Boolean values; when checked, the characteristic of the associated labeled value is applied, when not, the characteristic is not applied (Note, this is for computerized and non-computerized checkboxes - for example, a printed form with the checkbox would require this same knowledge)

Syntactic knowledge: This is variable. One can press (by hand or with a stylus) the checkbox or label to add or remove a

check in the box; one can bring the cursor over the box and left click; one can tab over to the control and select. Even this simple example illustrates a broad range of applicable syntactic knowledge, some of which are more intuitive to use than others. The goal of usability design is for syntactic knowledge requirements to disappear, i.e., one relies on the user's semantic understanding as much as possible - I think this is what people mean when they say that an interface is intuitive. For a given class of users with semantic knowledge, the interface allows them to naturally perform their work without too much effort to learn how to use the system.

However, there are higher levels of affordance that come with learning. As Gibson (1979) noted, a mailbox affords "insertability" but a human can learn that it also affords "mailability." The designer hopes this label and checkbox affords the user the action possibility of indicating that this is a "customized" installation, in affordance-like terms, the label and checkbox affords "customizability characterizing" for a given contract. Users would have to have semantic knowledge about what a customized installation is and syntactic knowledge that this label and checkbox would provide a way to record this.

Example - Illustrating CoAct with "Save As" Command

A client uses MS Word on a frequent basis, but only needs to use the "Save As" command once every six months when the new brochure is created from the old one. The user gets confused and is afraid that this command will overwrite the existing file and she will lose the contents of this document. Every six months this user needs to confirm that this command will make a copy and not overwrite the existing file.

Figure 10 depicts a CoAct-based analysis of the "Save As" command. Although this command is second-nature to people who frequently use this command in MS Word, there is a heavy burden of what capabilities are needed for users to be in the same class for this command to afford everything that is does.

In addition to the "Save As" command for experienced users, it may make sense to have another command, such as "Save Copy" that reduces the capability requirements for users who infrequently copy files (Figure 11). Users could select "Save Copy" and an interactive session could ensue that provides the infrequent user "locus of control" (Preece, 1994), where the user is allowed to close the existing document without changes and to make the new copy of the active document. Informally, when students enrolled in a usability engineering class are asked to step back and identify the problems with "Save As," they can readily identify the problems for the infrequent user of this command. CoAct provides an affordance-based model to guide such evaluation without needing to rely on internal representations, such as mental models.

This example also illustrates the case where actors can move in and out of classes of actors with capacities to act. Actors can learn new capacities for which the environment affords desired action opportunities, but then they can forget and the same environment no longer affords the same action opportunities. For example, the infrequent user is attuned every six months and the "Save As" command within the list of file commands affords her the opportunity to create a copy without modifying the original. However, six months later, when she forgets, the same list of commands no longer affords her the same action opportunity.

SUMMARY

Models of collaboration that rely on internal representations, such as mental models, to filter sense-data are problematic. Folk theories that purport to have "privileged knowledge" about the internal workings of the mind may be true, but they are not falsifiable. In line with Gibson's

Figure 9. Part of a job contracting screen

Figure 10. CoAct-based analysis of the "save as" command

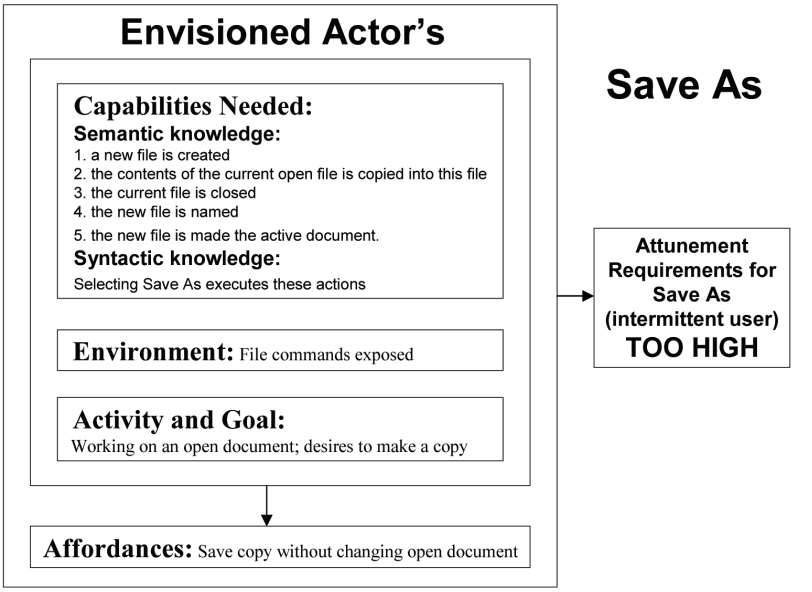
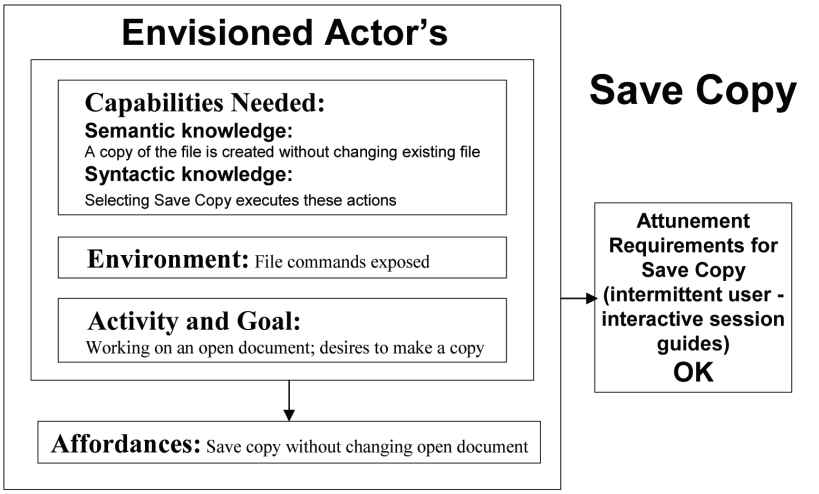


Figure 11. CoAct-based analysis of the "save copy" command



view of the potentially broad application of his ecological theory of affordance, CoAct extends the notions of affordance and moves away from idiosyncratic, subjective mental models of the world to the notion that actors with similar capacities to act can potentially discern similar action possibilities in the world. It changes the direction from discovery and alignment of internal representations to mutual attunement of collaborators to build sufficient capabilities, share informational structures, and calibrate selectivity to achieve shared affordances.

Preliminary results of initial experiments to test CoAct were presented and provide some support for CoAct. Two interface design examples were presented to demonstrate the applicability of CoAct to usability design. More research is needed, but this work has the potential to impact the design and teaching of human-machine interfaces, provide guidance on reducing data overload among classes of users with different capacities to act, and improve collaborative decision making.

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REFERENCES

Adams-Webber, J. R. (1979). *Personal construct theory: Concepts and applications*. New York, NY: John Wiley & Sons.

Bloor, D. (1983). *Wittgenstein: A social theory of knowledge*. London, UK: Macmillan.

Boland, R. J., & Tenkasi, R. V. (1995). Perspective making and perspective taking in communities of knowing. *Organization Science*, *6*(4), 350–372.

Boyle, R. J., Kacmar, C. J., & George, J. F. (2008). Distributed deception: an investigation of the effectiveness of deceptive communication in a computer-mediated environment. *International Journal of e-Collaboration*, *4*(3), 14–39.

Brand, G. (1979). *The essential Wittgenstein*. New York, NY: Basic Books.

Cannon-Bowers, J. A., Sala, E., & Converse, S. A. (1993). Shared mental models in expert team decision making . In Castellan, N. J. Jr., (Ed.), *Individual and group decision-making: Current issues* (pp. 221–246). Mahwah, NJ: Lawrence Erlbaum.

Clancey, W. J. (1997). *Situated cognition: On human knowledge and computer representations*. Cambridge, UK: Cambridge University Press.

Dictionary.com. (n. d.). *Attunement.* Retrieved from http://dictionary.reference.com/browse/attunement

Endsley, M. R. (1995). Toward a theory of situation awareness in dynamic systems. *Human Factors*, *37*(1), 32–64.

Endsley, M. R. (2001). A model of inter- and intrateam situational awareness: Implications for design, training, and measurement . In McNeese, M., Salas, E., & Endsley, M. (Eds.), *New trends in cooperative activities* (pp. 46–67). Santa Monica, CA: Human Factors and Ergonomics Society.

Fallot, M., Martinez-Carreras, M. A., & Prinz, W. (2010). Collaborative distance: A framework for distance factors affecting the performance of distributed collaboration. *International Journal of e-Collaboration*, *6*(2), 1–32.

Farooq, U., Carroll, J. M., & Ganoe, C. H. (2008). Designing for creativity in computer-supported cooperative work. *International Journal of e-Collaboration*, *4*(4), 51–75.

Fransella, F., & Bannister, D. (1977). *A manual for repertory grid technique*. New York, NY: Academic Press.

Gentner, D., & Stevens, A. L. (Eds.). (1983). *Mental models*. Mahwah, NJ: Lawrence Erlbaum.

Gephart, R. P. (1993). The textual approach: Risk and blame in disaster sensemaking. *Academy of Management Journal*, *36*(6), 1465–1514.

Gibson, J. J. (1979). *The ecological approach to visual perception*. Boston, MA: Houghton-Mifflin.

Habermas, J. (1984). *The theory of communicative action: Reason and the rationalization of society*. Boston, MA: Beacon Press.

Heft, H. (2001). *Ecological psychology in context*. Mahwah, NJ: Laurence Erlbaum.

Hollnagel, E., & Woods, D. D. (2005). *Joint cognitive systems*. Boca Raton, FL: CRC Press.

Johnson-Laird, P. (1983). *Mental models*. Cambridge, MA: Harvard University Press.

Kock, N., & Nosek, J. T. (2005). Expanding the boundaries of e-collaboration. *IEEE Journal of Professional Communication*, *48*(1), 1–9.

Larman, C., & Vodde, B. (2009). *Scaling lean & agile development: Thinking and organizational tools for large-scale Scrum*. Reading, MA: Addison-Wesley.

Leventhal, L., & Barnes, J. (2007). *Usability engineering: Process, products, and examples*. Upper Saddle River, NJ: Prentice Hall.

Norman, D. A., & Draper, S. W. (1986). *User centered system design*. Mahwah, NJ: Lawrence Erlbaum.

Nosek, J. T. (2005). Collaborative sensemaking support: Progressing from portals and tools to Collaboration Envelopes™. *International Journal of e-Collaboration*, *1*(2), 25–39.

Osgood, C. E. (1969). The nature and measurement of meaning . In Snider, J. G., & Osgood, C. E. (Eds.), *Semantic differential technique*. Chicago, IL: Aldine Publishing.

Pick, J. B., Romano, N. C. Jr, & Roztocki, N. (2009). Synthesizing the research advances in electronic collaboration: Theoretical frameworks. *International Journal of e-Collaboration*, *5*(1), 1–12.

Pizlo, Z. (2001). Perception viewed as an inverse problem. *Vision Research*, *41*(24), 3145–3161.

Pizlo, Z. (2007). Human perception of 3D shapes. In W. G. Kropatsch, M. Kampel, & A. Hanbury (Eds.), *Proceedings of the 12th International Conference on Computer Analysis of Images and Patterns* (LNCS 4673, pp. 1-12).

Preece, J. (1994). *Human-computer interaction*. Reading, MA: Addison-Wesley.

Remidez, H. Jr, Stam, A., & Laffey, J. M. (2010). Scaffolding solutions to business problems: Trust development as a learning process. *International Journal of e-Collaboration*, *6*(4), 12–31.

Rosson, M. B., & Carroll, J. M. (2002). *Usability engineering: Scenario-based development of human computer interaction*. San Francisco, CA: Morgan Kaufmann.

Shannon, C. E., & Weaver, W. (1969). *The mathematical theory of communication*. Urbana, IL: University of Illinois Press.

Stassen, H. G., Johannsen, G., & Moray, N. (1990). Internal representation, internal model, human performance model and mental workload. *Automatica*, *26*(4), 811–820.

Vivacqua, A. S., & Moreira de Souza, J. (2008). The vineyard approach: A computational model for determination of awareness foci in e-mail-based collaboration. *International Journal of e-Collaboration*, *4*(1), 41–59.

Weick, K. E. (1979). *The social psychology of organizing*. Reading, MA: Addison-Wesley.

Wilson, B. (1998). *Wittgenstein's philosophical investigations: A guide*. Edinburgh, UK: Edinburgh University Press.

Yufik, Y. M., & Georgopoulos, A. P. (2002). Understanding understanding: Modeling cognitive mechanisms of comprehension in complex dynamic tasks. In *Proceedings of the Technology for Command and Control Workshop: Cognitive Elements of Effective Collaboration* (pp. 91-96).

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Working Effectively in a Matrix:
Building and Sustaining Cooperation

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ABSTRACT

The complexities of today's organizations have made it increasingly challenging for leaders to encourage and sustain a culture of cooperation. As organizations become flatter and leaner and people are required to do "more with less," the key to success is the ability to coordinate decisions and actions across organizational boundaries and gain the support of people who often have competing priorities or conflicting goals. Further, the increasing prevalence of virtual teamwork and widespread use of e-collaboration tools have additional implications for how leaders encourage cooperation and coordinate work. This article explores the critical organizational factors and leadership skills that are required to build a culture of cooperation in today's highly matrix, and often virtual, organizations.

Keywords: *Culture of Cooperation, E-Collaboration, Organizational Factors, Virtual Organizations, Virtual Teamwork*

INTRODUCTION

If you have ever worked in a public or private organization of any size you know that cooperation and coordination are critical for effective execution and organizational success. It is almost impossible to get anything important done without the assistance and joint efforts of others. Yet, despite the fact that there is little argument about the role coordination and cooperation play in the execution of plans and initiatives, it appears that they are elusive and difficult to attain.

In a matrix organization—where people rely on getting work done through others over whom they have no direct authority—maintaining high levels of cooperation and coordination can be a challenge. Added to this is the increasing prevalence of e-collaboration in today's organizations. OnPoint's 2011 study of over 900 leaders across industries found that 53% of their organizations used virtual teams and 57% employ telecommuting, where people work remotely from home. The virtual nature of the work, coupled with the need to work across organizational boundaries, makes it even more difficult for today's organizations and leaders to create and sustain high levels of cooperation and coordination. Our study revealed some surprising findings related to the extent to which organizations struggle with this:

- Only 47% responded favorably to the item, "decisions and actions are well coordinated across departments/functions."
- Only 49% responded favorably to the item, "decisions and actions are well coordinated across levels of management."

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- 40% **do not** believe that people cooperate across functions and departments to achieve their organization's strategic objectives.
- 44% **do not** believe that people in different divisions readily share information, ideas, and best practices.

Given the challenges and complexities of today's organizations, what can leaders do to encourage and sustain cooperation? Our research suggests that there are three key elements that need to be in place to build a culture of collaboration, and there are two core skills that are critical for leaders to master in order to effectively cooperate in a global matrix structure.

THE THREE COOPERATION BUILDERS

Encouraging and sustaining cooperation and collaboration with people you depend on to get things done can be a daunting challenge. However, it is not an insurmountable one. There are certain conditions that predict when cooperation is more likely to trump competition—namely, when communication is clear and there is transparency about intent, when people understand what they can expect from others and how they will work together, and when the interests of individuals or groups are aligned. We refer to these elements as the Cooperation Builders, and they are critical for encouraging high levels of coordination (Lepsinger, 2011).

Cooperation Builder #1: Improve Communication and Transparency

When we communicate our intent to cooperate, we can increase the likelihood the other person will respond in kind. This, of course, assumes that our communication is clear and our intentions are understood. Unfortunately, this is not always the case. Although people often act with good intent and do what they think is right, they are often unable to coordinate their actions because of a breakdown in communications.

The most common mistake is assuming the other person understands what we want or intended. The lesson for leaders is simple: don't make this assumption. Develop the habit of being explicit about *why* you are doing something or making a request. Another mistake is not taking the time to do a "comprehension check" by paraphrasing to ensure understanding and, when appropriate, asking questions to confirm the other person's understanding of actions and next steps.

These two simple actions—not assuming people know what you are thinking and paraphrasing to check for understanding—can go a long way toward making communication clear and transparent and help prevent communication-related missteps. In a virtual organization that relies on significantly more e-collaboration, leaders operate with little face-to-face contact or visual cues which can enhance understanding. In this situation, the effective use of paraphrasing is even more essential. In addition, top performing virtual teams and team leaders leverage technology for communicating (e.g., weekly teleconferences, appropriate use of email, Instant Messaging, webinars) and effectively identify the most appropriate technology to enhance transparency and ensure mutual understanding (DeRosa & Lepsinger, 2011).

Cooperation Builder #2: Agree On When Cooperation Is Needed and What It Looks Like

Lack of clarity about roles and responsibilities is another cooperation-crusher. It results in conflicts among team members or groups. It also allows key responsibilities to "fall through the cracks" because each party believes that someone else is responsible for them. It seems our level of cooperation is generally higher when everyone involved agrees on when it is needed and what it looks like in these situations. When we know what to expect from other people we are more willing to trust them and take the risk of cooperation.

Here is an example: A U.S. based, wholly owned subsidiary of a Japanese pharmaceutical company found its growth objectives threatened

because of role ambiguity and the resulting lack of cooperation and coordination among members of its R&D function. When the company was smaller, each therapeutic head had been able to carve out a comfortable niche for his or her area, a practice that continued as the company grew. Each manager acted as if his or her development projects had the highest priority.

Managers frequently ignored requests or decisions they disagreed with and seldom worked with colleagues to coordinate activities that required shared resources (such as clinical trials and the timing of regulatory submissions). As a result, many projects were behind schedule and the leaders in Japan were losing confidence in the teams' ability to deliver on their commitments.

Although individual conversations were held with each member of the R&D team to encourage cooperation, there remained a fundamental difference of opinion about roles and who needed to be involved in key decisions. What was the solution? The team conducted a meeting to list the decisions and activities for which they shared accountability. Using that list as a starting point, the team discussed and agreed on the level of authority and degree of involvement each person needed to have in order to ensure work was done efficiently, on time, and well.

The agreements were then documented and distributed to each manager's department so the behavior of direct reports would be consistent with the agreements reached by the managers. The tool this R&D team used is commonly referred to as the RACIN model. The tool, whose acronym stands for five levels of authority and involvement—*Responsible, Approve, Consult, Inform*, and *Not Involved*—enables individuals and teams to describe what cooperation and collaboration looks like for the most important decisions and activities for which they are responsible.

As we saw in the R&D team example, the team starts by listing the critical decisions and activities for which they are accountable and then discusses and reaches agreement on who has which role. The process takes time but it is well worth the investment. On their own, some teams may eventually come to an understanding about when and how to work together. That journey, however, takes much longer than a RACIN meeting and relationships and trust can be damaged along the way.

The reality is that when left to its own devices, the team is likely to never reach a sustained level of cooperation as its members repeatedly work through misunderstandings and conflicts. Formally and explicitly working out roles at the early stage of a team's formation, or whenever you notice a lack of cooperation, helps accelerate the process and preserve trust.

Clearly articulated goals, roles, and accountabilities are particularly important to success in environments where e-collaboration is prevalent. While e-collaboration tools are not a substitute for face-to-face contact in a virtual setting, leveraging tools such as instant messaging, email, chat rooms, and websites to provide team members with updates and reinforce goals can go a long way in ensuring success. For example, posting a "team handbook" on a shared site with background on each team member and each person's respective role is one way of communicating and reinforcing roles and responsibilities. Periodic e-newsletters are another way to provide team members with updates and create a shared understanding of roles, goals, and priorities.

Clarifying roles and responsibilities not only defines when cooperation is necessary and what it looks like, it also reinforces the norm that cooperation is expected and appropriate. However, to get cooperation you must demonstrate cooperation. If you or members of your team take the first step and model cooperative behavior you will increase the likelihood that the people you depend on to get work done will respond the same way. Through your behavior at work you can signal that cooperation is the expectation, encourage others to reciprocate in kind, and, when they do, demonstrate that they will not be taken advantage of.

Cooperation Builder #3: Align Interests and Establish Common Ground

When the objectives of one person or group are at odds with the objectives of another, cooperation and collaboration suffer.

Picture the potential conflicts and inefficiencies that would result if one group in your department was working toward reducing costs, while another group was focused on bringing state-of-the-art products and services to market. These objectives can coexist, but it most likely won't happen on its own. To facilitate alignment between the two groups, leaders must develop compatible and mutually supportive objectives in a thoughtful and explicit manner.

One approach is to develop a set of broader, collective objectives for a team or work unit, then review the task objectives for specific individuals or groups and ensure that they are consistent with and mutually supportive of the collective objectives. For example: to set the stage at the beginning of the year, the Chief Technology Officer of a large brokerage firm and his boss identify the ten critical objectives for the organization. These are goals that reflect its mission and are necessary for the overall success of the business enterprise. After the extended management team briefly reviews the goals, in-depth work is done to ensure that each will be accomplished.

Cross-functional teams discuss the goals in concurrent sessions to clarify, fine-tune, and determine what it will take to accomplish them, including key deliverables, help required, mileposts, key stakeholders, and so on. Following these discussions, the individual with primary accountability for a particular goal reports on the overall plan, identifies areas that require problem solving, and explains how progress and success will be monitored and communicated throughout the year.

After all the goals have been discussed, possible overlaps, synergies, trade-offs and barriers are highlighted and resolved. The process results in clarity among members of the extended team on priorities, resource allocation, and role expectations.

DISAGREEMENT HAPPENS: HOW TO RESOLVE CONFLICT AND MAINTAIN SUPPORT

Although the cooperation builders set the stage and provide a foundation to encourage cooperation, they won't eliminate disagreements about what and how to do things—and they won't change the fact that people have different priorities, make mistakes, and sometimes, fail to meet others' expectations. In order to sustain cooperation and collaboration, leaders must gain the support of others for their ideas and constructively resolve differences across organizational boundaries.

Eleven Tactics for Influencing Others

Despite having shared goals in place, a leader's success often depends on his or her ability to gain the support and cooperation of people who have competing priorities and/or conflicting goals. The effective use of influence is the most powerful tool a leader has to create alignment and build commitment in these situations.

The most common form of influence behavior is a "simple request": *Please provide me with the report by Friday; Could you please prepare a summary of the results by close of business today?* A simple request is appropriate when compliance is all that is needed and the person being influenced views the request as legitimate, relevant for the work, and something that would be relatively easy to do (i.e., he or she knows how to do it, has the required resources, etc.). However, if the requested action would be unpleasant, inconvenient, or irrelevant, the person's reaction is likely to be resistance. In these situations, a "simple request" would not suffice and it is necessary to use other forms of influence behavior called a "proactive influence tactic." There are 11 proactive influence tactics (Table 1) that are relevant for influenc-

Table 1. The Most Effective Tactics

Most Effective	Moderately Effective	Least Effective
- Rational Persuasion - Inspirational Appeals - Consultation - Collaboration	- Apprising - Ingratiation - Personal Appeals - Exchange	- Legitimating Tactics - Coalition Tactics - Pressure

ing direct reports, colleagues, and bosses that we categorize based on their effectiveness in gaining commitment (Yukl, 2002):

Four "core tactics" are most effective at gaining commitment. They are *rational persuasion, inspirational appeals, consultation*, and *collaboration*. Following is a description of each.

Rational Persuasion involves the use of explanations, logical arguments, and factual evidence to explain why a request or proposal will benefit the organization or help to achieve an important task objective. This tactic can be effectively used in all directions (with bosses, colleagues, and direct reports) and is particularly powerful when you are seen as an expert or have a track record of success. The key to using rational persuasion is the ability to convert features into benefits—*benefits as seen by the person you are influencing*. Following is an example of the use of rational persuasion:

Jim manages a team that generates reports that field personnel depend on to provide effective client service. The system his staff currently uses is old, inefficient, and often malfunctions. Since Charlotte recently left the department, Jim's team has had to put in extra time to keep things running smoothly. Citing budget constraints, management has postponed replacing Charlotte. Jim recently met a programmer who has extensive knowledge of a new system that would require significantly less manual labor. Jim would like to hire this person and needs to convince his boss to approve the hiring decision. Jim says to his boss: "I'd like to talk with you about hiring a programmer to implement a new system in our department. Compared to our existing system, this new system has greater accuracy and requires significantly less manual labor. I recently ran some numbers that I'd like to share with you that indicate the new system would boost our productivity by at least 10%. In addition, the new system would enhance morale and help us retain top performers."

Inspirational Appeals involves an emotional or value-based appeal, in contrast to the logical arguments used in rational persuasion. While rational persuasion appeals to the "head", inspirational appeals focuses on "the heart". It is more effective with direct reports and peers than with bosses and requires an understanding of the other person's values and motivators. A common misconception is that inspirational appeals requires a leader to be "rah rah" and highly charismatic. This is not the case—in fact, if a leader is effective at using rational persuasion, he or she can be just as effective at using inspirational appeals. The difference is that—with inspirational appeals--benefits are positioned in a more value-oriented manner. Following is an example of the use of inspirational appeals:

Linda is a member of a cross-functional task force charged with developing recommendations to enhance existing project management processes. Recently, Linda was asked by the leader of the task force to head up a new project. One of the key people she will need support from is Joe, a peer of Linda's who is also part of the task force. Linda knows that Joe is very busy with other work for the task force as well as his daily job responsibilities. Linda has worked

with Joe for a number of years and knows that he is particularly motivated by achievement and excellence. In her first meeting with Joe she says, "I know it will be a challenge and the goals we've set out are a stretch—but I believe we have what it takes to be successful. The new approach we develop will be much better than anything done in the past and we have the opportunity to build it. When we successfully complete this project there is no question in my mind that we will have a significant and lasting impact on organizational performance."

Consultation involves asking a person to suggest improvements or help plan a proposed activity or change for which his/her support is desired. With this tactic the other person is invited to participate in planning how to carry out a request or implement a proposed change. Following is an example of the use of consultation:

Susan is the manager in charge of developing a new system to process financial transactions that will provide a significant cost savings to the company. She is new to the position and her experience has been in other areas of technical development. John built the current system and is the manager in charge of running and maintaining the system. His expertise will be essential in designing the new system. Susan knows John is very busy with other priorities, yet without his direct involvement, she can't be sure she is making the best decisions. In her meeting with John she says, "I'd like to get your thoughts on the best approach to developing the new system. Based on conversations with users and my team, I have a beginning idea about how to get started. But I wanted to get your input to help refine the idea and increase the likelihood of success. What are your thoughts on the next steps and from your experience what are some of the pitfalls we need to avoid?"

Collaboration involves offering to provide relevant resources or assistance if the person will carry out a request or approve a proposed change. Like consultation, collaboration is participative, but the focus of collaboration is on reducing difficulty or costs of carrying out a request. This tactic is most effective with peers. Following is an example of the use of collaboration:

Bill is struggling to meet a critical deadline for an important project he is working on for his boss. The deadline is two days away, and Bill knows he won't be able to hit the deadline without help from Andy, one of his colleagues, who is more familiar with the system required to analyze the data Bill needs. Bill approaches Andy and says, "I'm concerned about being able to meet my deadline and I was hoping to get your help." Andy says that he has been working long hours to respond to a request from one of the organization's key clients and taking this on would be difficult. In response, Bill suggests, "What if I identify and organize the relevant data files, which is the most time consuming part of the work. That way you would just have to run the analyses and I can take that and finish the report."

It is more challenging to gain others' support and commitment without face-to-face contact. However, the appropriate use of e-collaboration tools can facilitate a leader's ability to influence from a distance. For example, email or a webinar can be used to make a rational argument by clarifying the benefits of a proposal. Using email to summarize the key features and benefits of your plan or proposal as follow up to a conversation can also be very effective. Instant Messaging can be used to support the tactic of consultation. The immediate, real time exchange of ideas replicates the spontaneity of a face-to-face discussion. Te best virtual leaders are able to effectively match the technology to the influence approach necessary.

The Moderately Effective and Least Effective Tactics

The moderately effective tactics are likely to result in compliance rather than commitment and are more effective for influencing direct

reports and peers (they are less effective in an upward influence attempt). They include:

- Apprising: Explaining how carrying out a request or supporting a proposal will benefit the person personally or will help to advance the person's career.
- Ingratiation: Using praise and flattery before or during an attempt to influence someone to carry out a request or support a proposal.
- Personal Appeals: Asking the person to carry out a request or support a proposal out of friendship, or asks for a personal favor before saying what it is.
- Exchange: Offering something the person wants, or offering to reciprocate at a later time, if the person will do what you request.

The least effective tactics can be thought of as the "last resort" tactics, since at best, they will result in compliance with a request and, if overused, will erode trust. However, they are legitimate approaches particularly when the stakes are high and other tactics have been used without success. They include:

- Legitimating: Establishing the legitimacy of a request or verifying that you have the authority to make it.
- Coalition: Enlisting the aid of others, or using the support of others, as a way to influence someone to do something.
- Pressure: Using demands, threats, frequent checking, or persistent reminders to influence someone to do something.

Manage Differences and Reach Agreement

In addition to gaining support and commitment, leaders must be able to effectively manage differences and reach agreement to build a culture of collaboration and succeed in a matrix. The word "conflict" often conjures up images of confrontation and anger, but this is frequently not the case. Disagreements occur in even the most positive and productive work relationships—at least, they should. Conflict itself is neither inherently good nor bad—what is positive or negative is how the differences are managed and the outcome that results. Surprisingly, OnPoint's 2011 study found that nearly half of respondents *do not* believe that leaders effectively manage or resolve conflict in their organizations.

What does it take to manage conflict effectively? For one, conflict needs to be acknowledged. When conflict is brought to the surface, problems can be addressed and people can take action to resolve issues. Many people avoid or minimize conflicts in an attempt to maintain harmonious relationships. This is a mistake because the problem may never be resolved. And while not all problems can be resolved to everyone's satisfaction, recognizing that conflict exists and attempting to deal with it is preferable to ignoring the situation. Many a solid long-term relationship is born from the difficult but constructive resolution of a conflict.

Another key to managing conflict is clarifying the source of the conflict. Differences of opinion concerning one or more of the following four issues will cause conflict to occur: facts, methods, goals, and values. Differences of *fact* are the most straightforward conflicts to resolve. Facts are concrete. They can be checked, compared, and tested, and this provides a basis for discussion and the exchange of information. Conflicts over facts can be resolved through dialogue more often than conflicts involving the other basic issues.

Methods are the second issue over which a conflict may arise. People may have similar goals and agree on the facts, but may be unable to agree on ways to achieve their goals. However, the presence of similar goals means that a logical, rational way of choosing among alternative approaches is possible. It's just a matter of convincing everyone that a particular method will achieve the goals at hand.

To illustrate, two production managers are trying to rework an assembly-line process, and they each prefer a different method for accomplishing their goal. At meetings they

each promote their preferred method with little progress toward agreement—until, that is, they realize they share the goal of improving assembly line efficiency. Once this common ground is established the two managers are able to look at each method more objectively. It now becomes a matter of reviewing the facts to determine which method does the best job. And because the managers have a shared goal they can focus on finding the method that "is the best" rather than on the one they "like the best."

When the issue is related to *goals*, people have different objectives and may be supporting different courses of action. Information sharing is the key to resolving conflicts over either methods or goals. It helps each person understand what is important to the other person. Occasionally, when differing goals exist, a third person may be needed to determine which goal (or combination of goals) is most appropriate.

For example, a cereal company's marketing group wants a package redesigned in a certain way to make it more attractive and to increase sales. The distribution group feels the new design will lead to breakage problems and will affect their quality standards. Once each group understands the needs and goals of the other they can focus on developing a solution that works for everyone (in this case a redesign that was more attractive and did not create breakage problems). If they are unable to find a solution that meets the goal of both groups they may need to involve the Product Manager to clarify which goal has the higher priority.

Conflicts arising from different values are most difficult to resolve. In fact, they are often not able to be resolved. People's beliefs tend to become inflexible over long periods of time, and are often based on emotion rather than on reason. Finding common ground and separating those that are not solvable from those that are frequently moves such conflicts toward productive action.

For example, the general manager of a manufacturing company feels that it's inappropriate to have alcoholic beverages at the annual picnic. Most of the team members feel that, since it is their picnic, they should have the right to determine the way the picnic fund is used. This conflict is almost impossible to resolve without creating some ill will or resentment because it is based on personal preferences and beliefs. If, however, a conflict is related to the core values of the organization, the organizational core values should override individual preferences.

Neglected conflicts have a tendency to grow. Generally speaking, a conflict left unresolved or unattended will morph from a conflict over facts, methods, or goals into a conflict over values—and in turn will become increasingly difficult to resolve. This underscores the importance of addressing conflict head-on.

Conflict is managed through a combination of assertiveness and cooperativeness. *Assertiveness* is defined as behaviors that are used to meet your own needs. *Cooperativeness* is defined as behaviors that are used to meet the needs of others. These two dimensions of behavior are not mutually exclusive—for example, you can work toward getting your needs met and, at the same time, work toward helping the person with whom you have a difference of opinion get her needs met—and yield five distinct conflict management styles. (Thomas & Kilmann, 1974). Finding the right balance between assertiveness and cooperativeness is key to managing conflict effectively—the right balance depends on the situation, what is at stake for the parties involved, position and role, time pressure, quality of the relationship, and the extent to which there are shared goals in place.

In general, to manage differences effectively, your mindset should be that people have the right to think or feel differently than you do and that it is to your benefit to develop solutions that will be acceptable and beneficial to everyone concerned. In a less-than-ideal world, however, people don't always hold that mindset. Here are a few mistakes they commonly make when trying to resolve conflicts:

- Minimizing or ignoring others' concerns
- Pulling power plays
- Attacking the legitimacy of the other person's position or priorities
- Suppressing differences

- Imposing their own goals/priorities
- Refusing to temporarily remove constraints
- Going through the motions of managing the difference, but refusing to carry it through

To avoid these pitfalls, it is best to clarify the situation by identifying the individuals involved in the conflict, identify the specific issues, and gather facts and perceptions of the people involved. A seven-step process for managing conflict can be applied to most situations:

1. Describe what's important to you and why
2. Check your understanding of what's important to the other person and why
3. Identify common ground and look for points of interdependence
4. Invite alternatives that address your needs/goals and those of the other person
5. Use active listening (paraphrase, questions, balanced response) to evaluate alternatives, resolve concerns, and improve ideas
6. If an alternative isn't immediately available, temporarily remove constraints to invite and propose new alternatives.
7. End the discussion by summarizing key points and stating next steps

SUMMARY AND IMPLICATIONS FOR E-COLLABORATION

Organizations are complex structures with many interdependencies. We must rely on others to help get things done and meet our objectives, and that means cooperation and collaboration are often the key to our success. The challenge leaders face in the workplace is to ensure the conditions that create and sustain cooperation and collaboration are in place. This is even more challenging in a virtual environment.

Given the widespread use technology for e-collaboration, leaders must understand how to best leverage technology to help build a culture of collaboration and be aware of situations where a face- to-face or telephone conversation would be beneficial. At times, an over-reliance on one type of technology may cause cooperation and coordination to break down. For example, when using email to solve a problem or make a decision, it can be difficult to check for understanding. Certain influence tactics (e.g., consultation, collaboration) are also difficult to use effectively without having a direct conversation with the other person. However, used appropriately, technology can greatly facilitate and reinforce high levels of collaboration and coordination. For example, e-collaboration tools such as shared intranet sites, e-newsletters, and webinars help to increase role clarity and reinforce goals and objectives.

Cooperation and collaboration are facilitated by clear communication, shared goals, and clearly defined roles. These conditions help encourage and motivate people to focus on the group's best interest without feeling that they are minimizing or trading off their own interests in the process. Once in place, however, cooperation is a delicate state. People will still have disagreements and different points of view about how and when things should happen. Leaders' ability to effectively and constructively influence others and gain their support is critical to maintaining cooperation.

Leaders who focus on these key areas will have much greater success in creating a culture of cooperation and achieving their business objectives in today's highly matrix and virtual organizations.

REFERENCES

DeRosa, D., & Lepsinger, R. (2010). *Virtual team success: A practical guide for working and leading from a distance*. New York, NY: John Wiley & Sons.

Lepsinger, R. (2010). *Closing the execution gap: How great leaders and their companies get results*. New York, NY: John Wiley & Sons.

Thomas, K. W., & Kilmann, R. H. (1974). *The conflict mode instrument*. Tuxedo, NY: Xicom.

Yukl, G., Seifert, C. F., & Chaver, C. (2008). Validation of the extended influence behavior questionnaire. *The Leadership Quarterly*, *19*, 609–621. doi:10.1016/j.leaqua.2008.07.006

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