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ORGANIZATIONAL TRANSITION TO ENTERPRISE RESOURCE PLANNING SYSTEMS: THEORETICAL CHOICES FOR PROCESS RESEARCH

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Abstract

The number of organizations implementing enterprise resource planning (ERP) software solutions is rapidly increasing. Transition to ERP systems is often combined with a business process reengineering effort and intended to produce radical organizational change. Prior to conducting research on ERP transition, researchers need to become aware of the theoretical choices available to guide their studies. In this paper, three dimensions of process theories used to explain organizational change are identified: *form*, *motor*, and *theoretical content*. Whereas form deals mainly with the amount and frequency of change, motor refers to the mechanisms explaining how and why change unfolds, and theoretical content consists of specific constructs and their interactions that produce change. In order to make complete theoretical choices, researchers should consider all three dimensions of change in the design of their research. The three dimensions are combined in a framework that can guide research on ERP-related organizational transition.

1. INTRODUCTION

Technology-based organizational transitions have captured the interest of researchers for more than 40 years. Each major technological advance has prompted claims that organizations will be fundamentally altered (Robey and Boudreau 1999). The newest information technology to make this claim is enterprise-wide software solutions, more commonly called enterprise resource planning (ERP) systems. ERP systems, or packages, are integrated sets of modules that allow companies to manage multiple operations including manufacturing, human resources, finance, and logistics. ERP permits a company to replace mission-critical legacy systems—notorious for their age, size, complexity, inflexibility, and fragmentation—with fully integrated systems. ERP has become very popular because it promises significant business breakthroughs. It was predicted that the global ERP market would grow at a compound annual rate of 37% over the next five years, reaching $52 billion by 2002 (AMR Research 1997). Analysts have claimed that nearly every sizable manufacturer in the United States and Europe either has ERP, is acquiring ERP, or is considering acquiring it soon (Deutsch 1998).

Many companies are attracted to ERP because it implies fundamental organizational changes. Indeed, ERP usually instigates, or is instigated by, business process reengineering (Bancroft, Seip and Sprengel 1998). Along with an organizational transition to ERP, whole departments must be retrained, jobs redefined, and procedures discarded or rebuilt from scratch (Deutsch 1998), ultimately transforming core processes (Caldwell and Stein 1998). The business processes embedded in an ERP package allegedly represent best practices, from which adopting organizations are presumed to benefit. Benefits include streamlined business processes, better integration among business units, and greater access to real-time information by organizational members. For many organizations, the transition to an ERP system has the potential to provide dramatic gains in productivity and speed (Davenport 1998).

It is thus tempting for both researchers and managers to assume that the rollout of ERP will generate substantial organizational change. Indeed, ERP is often assumed to be a deterministic technology because enterprises are forced to align their work processes with those embedded in the software package (Glass 1998; Markus 1997). Although the processes embedded in an ERP may be customized through configuration tables,[1] modification of a package's software code to satisfy organizational idiosyncrasies is highly impractical. It is usually necessary for an organization to redefine its business processes to fit the best practices inherent in the software. Thus, ERP is often considered to be a unique kind of technological change, one that is capable of significantly transforming organizations.

Despite such expectations, past research provides little confidence that the transformational power of information technologies materializes as intended. Indeed, research results covering a variety of technologies implemented in many different kinds of organizations have revealed that changes induced by information technology are often resisted (Kling and Iacono 1989), that modification of intended changes is common (Kraut, Dumais and Koch 1989), and that unanticipated and contradictory changes may result (Robey and Boudreau 1999). Consequently, researchers should not automatically assume that the claims about ERP's deterministic effects are valid. ERP researchers should be aware that information technology has rarely confirmed prior expectations about its impacts and be suspicious about arguments that treat ERP as a special technology that has predictable consequences. Although ERP has greater scope than most information technologies and poses some distinctive constraints on business processes, organizational outcomes are not necessarily determined by ERP implementation. Rather, researchers studying ERP transitions need to be open to a wider variety of theoretical choices explaining organizational change. This paper presents a research framework to guide research on fundamental organizational changes associated with information technology, such as those expected from ERP transitions.

2. THEORETICAL CHOICES

To investigate ERP transition as organizational change, it is necessary to appreciate the different dimensions used in theories about organizational change. In this section, the choice of a process approach for studying ERP transition is first justified. Then alternative *forms*, *motors,* and *theoretical contents* of organizational change theories are evaluated. Each of these three dimensions of change provides a particular lens for viewing a phenomenon.[2] Form deals mainly with the amount and frequency of change. Motor refers to the mechanisms explaining how and why change unfolds. Theoretical content consists of specific constructs and their interaction, from which change occurs. Considering the panoply of theoretical choices available for studying organizational change, no single theory necessarily applies to ERP transitions. However, an understanding of the whole picture may shed light on the implications of different approaches for conducting ERP transition research.

2.1 Organizational Change as a Process

Studies about organizational change have typically concentrated on two questions: *what* are the antecedents or consequences of change and *how* does organizational change emerge, develop, grow, and terminate over time (Van de Ven and Huber 1990). Although researchers have manifested more interest in the first question, answering the second question gives greater insight into what happens between the antecedents and consequences of change, that is, the process of change. In this paper, a process approach is assumed to be more valuable in research designed to explain the dynamics of ERP transition.

A process approach to theory differs from a variance approach (Mohr 1982; Sabherwal and Robey 1995). Whereas the latter addresses the "what" question by predicting levels of outcome variables from levels of predictor variables, the former seeks to explain how outcomes develop over time (Markus and Robey 1988). In the information systems field, the process approach has

[1]The typical ERP contains 800 to 1,000 business processes that may be customized with the help of approximately 8,000 configuration tables (Glass 1998).

[2]Other dimensions could be added to the three we proposed. Woodman (1989), for example, applied seven "thematic" categories that reflect significant trends within the organizational change literature. Nevertheless, our purpose is to focus on more encompassing, "conceptual" categories underlying most organizational change research efforts.

historically been neglected in favor of variance models of inquiry.[3] However, process research models can be "valuable aids in understanding issues pertaining to designing and implementing information systems, assessing their impacts, and anticipating and managing the processes of change associated with them" (Kaplan 1991, p. 593).

Process theory is described in different ways in the literature (Sabherwal and Robey 1995; Shaw and Jarvenpaa 1997; Van de Ven 1992). In the study of ERP transitions, processes may be conceived as sequences of events that occur over time and lead to outcomes of particular interest. This approach to process theory differs from the approach of dividing processes into *a priori* stages, such as in Nolan's (1979) model describing the stages of IS growth in organizations. Stage models are limited because they portray only one possible sequence of events, through which all organizations are expected to progress. Researchers using *a priori* stages in their research may also find their results becoming self-fulfilling prophesies (Poole and Roth 1989). Hence, research on ERP transitions is likely to benefit more by treating processes as sequences of events that emerge over time, unconstrained by any *a priori* definition of stages of change. Larsen and Myers (1997), in their study about an ERP implementation ensuing from a reengineering effort, adopted such a process approach.

In the following sections, theoretical choices concerning form, motor, and theoretical content of change are discussed. Figure 1 displays these choices in a three-dimensional framework, which implies that a complete theory consists of specified form, motor, and content. Four forms of change are specified, including alternative forms that have appeared as additions to the three more traditional choices. Four motors drawn from the work of Van de Ven and Poole (1995) are also shown. Theoretical content is left open-ended because of the wide variety of theoretical content that may be used within process theories of organizational change.

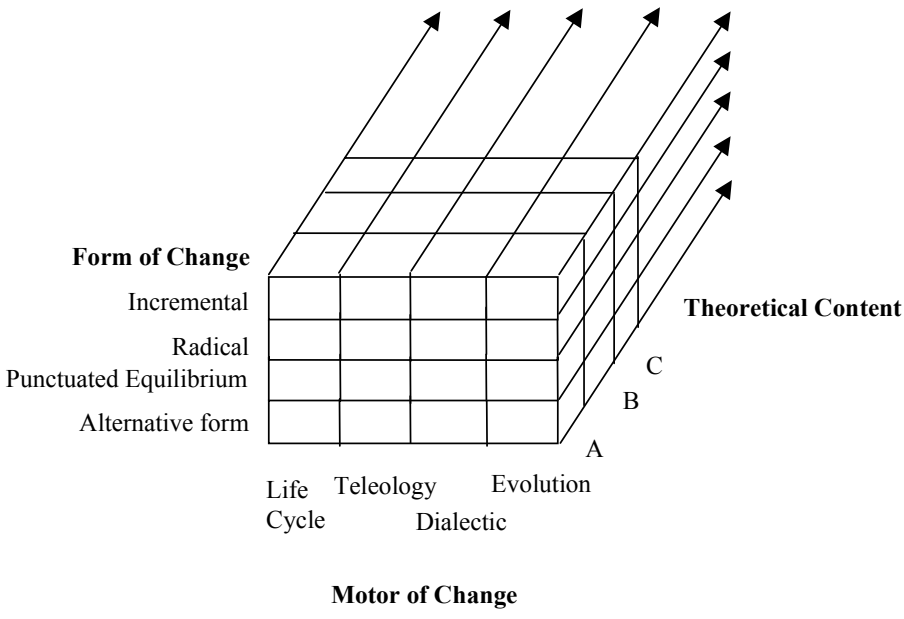

Figure 1. Dimensions of Theoretical Choices for Guiding Research on ERP Transition

[3]Orlikowski and Baroudi (1991) found that only 4.5% of the research conducted in information systems focused on issues of process.

2.2 Forms of Organizational Change

Forms of organizational change are typically described in terms of the magnitude and pace of change. Three main views have been taken: treating organizational change as *radical,* as *incremental*, or as *punctuated equilibrium*. Whereas the radical view describes organizational change as fundamental and discontinuous, the incremental view portrays change as consisting of minor improvements or adjustments. The punctuated equilibrium view combines elements of the preceding views, treating change as alternating between radical and incremental periods.

The radical view on change is often labeled as revolutionary (Tushman and O'Reilly 1996), second-order (Bartunek and Moch 1987), quantum (Miller and Friesen 1984), or strategic change (Nadler and Tushman 1989). Radical change is "so great that it must be considered a fresh start rather than an extension of what preceded it" (Kanter, Stein and Jick 1992, p. 173). It involves "breaking out of a current pattern of congruence and helping an organization develop a completely new configuration" (Nadler and Tushman 1989, p. 196). The radical view of change is carefully articulated by Miller and Friesen, who emphasize two dimensions of change: quantum and dramatic. On the one hand, change is considered quantum (as opposed to piecemeal) when many things change together, that is, when structures change in a concerted way. On the other hand, change is dramatic when elements quickly change a great deal. A revolutionary change, according to Miller and Friesen, is a change that is both quantum and dramatic. To illustrate, an ERP transition may be considered quantum if it requires simultaneous implementation of technological, business, organizational, and individual changes (Bancroft, Seip and Sprengel 1998). It may also be interpreted as dramatic if the transition employs a "rapid implementation" approach, using tools and methods to speed the process (Nanekamp, McGowan, and Mather 1999). Thus, an ERP transition may conform to a revolutionary form of change because it can be concurrently quantum and dramatic. Implementing multiple ERP modules at the same time in multiple divisions—termed a "big-bang" approach (Schneider 1999)—is indeed revolutionary.

An incremental form of change is also referred to as evolutionary (Tushman and O'Reilly 1996), tuning and adaptation (Nadler and Tushman 1989), or first-order change (Bartunek and Moch 1987). The incremental view contends that even large-scale organizational realignments result from continuous small-scale adjustments. Proponents of this view disagree about the degree of rational intent implied in incremental change. Some (e.g., Lindblom 1979) describe incremental change as piecemeal, remedial and disjointed—a form of patchwork rather than planned change. Others (e.g., March 1981; Quinn 1980) regard incremental changes as deliberate and purposeful. It has been argued that an ERP transition should be made evolutionary through phased rollouts that seek quick successes and generate momentum for later changes (Bancroft, Seip and Sprengel 1998; Schneider 1999). By selecting a limited number of modules to be implemented, a "small-bang" approach gives organizational members time to understand and assimilate change (Bancroft, Seip and Sprengel 1998). Moreover, ERP vendors and consultants may also benefit from such an incremental pace because of their own learning needs.

The punctuated equilibrium model of change (Tushman and Romanelli 1985) is a third form of change frequently mentioned in the organizational change literature. It claims to integrate the radical and incremental views (Choi 1995) by proposing two interrelated and alternating processes: a process of *convergence*, which operates through incremental change mechanisms, and a process of *reorientation*, wherein patterns of consistency are fundamentally reordered. Convergence is defined as a "process of incremental and interdependent change activities and decisions which work to achieve a greater consistency of internal activities with a strategic orientation and which operate to impede radical or discontinuous change" (Tushman and Romanelli 1985, p. 178). By contrast, reorientation is represented by relatively short periods of discontinuous change where strategy, power, structure, and controls are fundamentally transformed. Although ERP transition has not been studied as punctuated equilibrium, it is conceivable that the implementation of an ERP system be conducted incrementally and that its subsequent organizational impacts be regarded as radical (Lozinsky 1998).

Although radical, incremental, and punctuated equilibrium are the forms of change most commonly described in the literature, other variations have also appeared. For example, Henderson and Clark (1990) proposed "modular" and "architectural" technological changes as extensions to incremental and radical change. Likewise, Greenwood and Hinings (1996) distinguished between convergent, radical, revolutionary, and evolutionary change. For Greenwood and Hinings, the convergent-radical dichotomy involves the nature of change and the evolutionary-revolutionary dimension refers to the scale and pace of change. Whereas evolutionary change occurs gradually, revolutionary change happens swiftly and affects virtually all parts of the origination simultaneously. ERP transition could conceivably fit any of these alternative forms, as well as more conventional forms.

The variety of theoretical forms describing organizational change makes it difficult to choose any particular form to guide research on the process of ERP transition. Although it is often assumed that ERP systems precipitate radical change (Lozinsky 1998), empirical evidence is needed. Because prior research on organizational transformations associated with information technology has generally disconfirmed the expectations of radical change (Robey and Boudreau 1999), a more open posture on the form of ERP transitions is advocated. Researchers must be aware that organizational change may follow a variety of forms and should not assume a specific form associated with ERP.

2.3 Motors Driving Organizational Change

The form of change represents only one of the choices that researchers should consider when studying ERP transition. A second choice is the "motor," a metaphor employed by Van de Ven and Poole to describe the generative mechanisms contained within process theories of organizational change. Based on a comprehensive literature review of theories explaining the process of change, Van de Ven and Poole articulated four families of process theories, each identified by a particular motor, which explains processes of organizational change.[4] The four families of process theory are life cycle, teleology, dialectics, and evolution.

A *life cycle* motor adopts the metaphor of organic growth to explain organizational development from its birth to its death. According to life-cycle theory, "the developing entity has within it an underlying form, logic, program, or code that regulates the process of change and moves the entity from a given point of departure toward a subsequent end that is prefigured in the present state" (Van de Ven and Poole 1995, p. 515). An example of a life-cycle theory applied to IS implementation is Nolan's stage model. A *teleological* theory relies on the philosophical doctrine that goals guide organizational change. This approach assumes that an organization "constructs an envisioned end state, takes action to reach it, and monitors the progress" (Van de Ven and Poole 1995, p. 516). In IS implementation research, a teleological theory has been applied to the implementation of systems in health care (Paré and Elam 1997). In a *dialectic* theory, emphasis is on a "pluralistic world of colliding events, forces, or contradictory values that compete with each other, for domination or control" (Van de Ven and Poole 1995, p. 517). Under a dialectic motor, the interplay between two or more opposing entities produces new organizational forms. Dialectical reasoning is the basis for Robey and Boudreau's explanation of the organizational consequences of information technology, and it informs many political analyses of IS implementation (e.g., Markus 1984). Finally, an *evolutionary* theory of change refers to "cumulative changes in structural forms of populations of entities, [which occur] through a continuous cycle of variation, selection, and retention" (Van de Ven and Poole 1995, p. 518). Whereas variation refers to the creation of novel entities, selection occurs through the competition of these entities for scarce resources, and retention involves forces that perpetuate the entities' existence. Within the IS field, Segars and Grover (1995) used an evolutionary perspective to explain the differential impact of information technology across industries.

Selection of a motor is not simply a matter of choosing among these four alternatives. Rather, Van de Ven and Poole argue that most theoretical views on organizational change contain multiple mechanisms. For example, they consider the punctuated equilibrium as a dual-motor theory because it incorporates both *evolutionary* and *teleological* motors. The evolutionary motor of change operates for relatively long convergent periods but is punctuated by the relatively short operations of a teleological motor of change (Van de Ven and Poole 1995, p. 530). Van de Ven and Poole consider theories of change that include up to four motors, generating an array of 16 logically possible explanations of organizational change.

ERP researchers are advised to be open-minded when selecting a motor of change, just as they are advised to consider alternative forms of organizational change. A transition process may conform to any individual motor or to combinations of them. For example, an ERP transition could progress naturally through a sequence representing a life cycle of information technology maturity within the firm. Alternatively, ERP could be seen as teleological change, designed by managers' goals to integrate information systems around a new corporate vision. ERP transitions could also be viewed in dialectic terms as contests between established legacy systems and newly integrated architectures. Finally, an evolutionary motor could be employed by considering ERP solutions as the selection of best practices from the population of alternative applications. Companies failing to adopt ERP might even be threatened with extinction from more competitive firms in an evolutionary analysis. Thus, many motors can conceivably explain ERP transitions and researchers should consider a variety of explanatory mechanisms in formulating their studies.

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[4]They perused about 20,000 abstracts and read 2,000 papers, about 200 of which were found useful to identify different theories of change, which in turn were classified in the four families of theories (Van de Ven 1992).

2.4 Theoretical Content of Organizational Change

In addition to the choice of form and motor, researchers must specify the actual content of theory. Content describes the specific constructs of a theory, that is, the elements that are connected with each other within the theory's logic. Theoretical content explains why an organization changes over time by identifying how specific elements account for change. Theoretical content reflects the disciplinary orientation of the theorist. For example, theories of organizational change that are based on economic assumptions of rational choice explain change using constructs that differ from theories that reflect the assumptions of, say, organizational learning or organizational culture. These latter theories use constructs such as "organizational memory" and "cultural values" that explain persistence of organizational forms, in spite of economic reasons for transforming them. Choices of motor and form must fit with the choice of theoretical content, but motor and form do not determine the choice of theoretical content.

The third dimension of the framework in Figure 1 is open-ended because there are so many theories that can potentially explain organizational change. Van de Ven and Poole identified 14 exemplary theories for the 16 logically possible conditions in which organizational change may unfold, and these do not exhaust the variety of potential theoretical contents. Although it is not this paper's objective to enumerate all possible choices of theoretical content, an example should illustrate the importance of choosing a particular content. Assume that a researcher considers the form of change to be incremental, driven by a dialectic motor. These choices are important, but the theory is incomplete until it specifies the constructs that actually explain how change occurs. An incremental, dialectic theory with politics as its content is an obvious choice, given its emphasis on social groups with opposing interests and political action intended to establish and maintain social power (Bacharach, Bamberger, and Sonnenstuhl 1996). However, other theoretical content may also fit the incremental form and dialectic motor. For example, theories of organizational culture may be centered on a dialectic tension between established cultural practices and requirements for new practices (Clark and Soulsby 1995). Moreover, cultural change is likely to proceed incrementally, needing to overcome the inertia embedded in historical practices and values. A cultural analysis would not duplicate a political analysis, nor would it necessarily deal with issues of social power. Thus, a particular form and motor may accommodate multiple theoretical contents.

Other theories may also be applied to the study of ERP transitions. For example, theories of organizational learning are appealing because ERP represents a knowledge base that organizational members must learn. Because ERP packages cross organizational boundaries, users must learn to transcend their narrow, task-oriented views. Politics is another obvious candidate for guiding ERP transition research. Lozinsky acknowledges several political issues that may arise during and after ERP projects. For example, an ERP transition may create such a process focus that responsibilities are redefined and the existing hierarchy replaced. Numerous other theories, including economics and organizational culture that were illustrated above, may also provide suitable and innovative lenses for viewing ERP transition.

3. IMPLICATIONS: USE OF THE FRAMEWORK

The current popularity of organizational change in general, and ERP systems in particular, make the study of ERP transition an enticing proposition. Such research should be conceptually linked to sound theories of organizational change rather than undertaken with overly simple assumptions. This paper draws attention to the theoretical choices that underlie research on EPR transition, revealing more possibilities than the simple technological imperatives often associated with ERP. The framework may appear to portray too many theoretical avenues for studying ERP transitions, perhaps discouraging researchers by making the choices appear difficult. Which cube in the framework, one may ask, is the right one? How does one evaluate so many options? ERP researchers need to ask themselves these questions and the framework can help them to find answers. Rather than presuming that a single combination of form, motor, and theoretical content should guide research on ERP transition, the three-dimensional framework suggests that a variety of approaches may yield valuable insights.

Specification of each of the theoretical dimensions may be decided *a priori* by the researcher, leading to the generation of propositions that could be tested with empirical data. For instance, one could hypothesize that the dialectical forces embodied in the organizational learning process of an ERP transition correspond to the form of change described as punctuated equilibrium. Such an investigation would conform to the paradigm of positivist science because it presumes the existence of causal relationships in advance of empirical confirmation. The chosen theory would guide the specification of the particular forces at work in the

dialectic process (e.g., organizational memory versus newly created knowledge), help to establish criteria for measuring the expected form of change (incremental, radical, or otherwise), and suggest means for a fair test of hypothesized relationships. While few process theories are sufficiently developed to guide positivist inquiry (Shaw and Jarvenpaa 1997), the framework helps to identify the basic dimensions of available theories.

If the researcher judges that no single dimension, or even combination of dimensions, is ready to be subjected to positivist testing in the context of ERP transition, the framework may be used *a posteriori*. Working within an interpretive research paradigm (Walsham 1993), a researcher may find that dimensions of the framework conform to data reflecting participants' subjective experiences during an ERP transition. Moreover, the researcher may identify different interpretations among different actors involved with the transition. For example, an IS manager may view the transition to ERP as a politically motivated revolutionary change, while an external consultant may interpret the same transition as a natural and incremental stage in a life cycle of IT maturity. Although participants are unlikely to use the terminology proper to theoretical forms, motors, and contents, the framework can aid in drawing out concepts expressed in participants' own language, stories, and metaphors.

Whether used *a priori* or *a posteriori*, the framework may guide researchers in three specific ways. First, it draws attention to a researcher's need to make complete theoretical choices. That is, forms must be coupled with motors and with theoretical contents to make a complete theoretical statement. Much research has focused on only one dimension at a time while excluding other dimensions. For instance, Sawyer and Southwick (1997) chose to concentrate on the form (i.e., the temporal dimension) while studying the transition to client/server systems. Pawlowski, Boudreau and Baskerville (1999) focused on a particular motor (i.e., dialectical) in their study of the impact of ERP on job flexibility. Volkoff (1999) used a particular theoretical content, "structuration theory," to interpret the adaptation process involved within two ERP implementations. Although such research may produce valid and insightful conclusions, each remains an incomplete theoretical explanation of organizational change. Researchers guided by the framework should thus consider the form, the motor, and the content of theories to examine the process of ERP transition more thoroughly.

Second, the framework may suggest new ways to look at a phenomenon. Rather than presenting only conventional approaches to study transition, the framework reminds researchers to consider less common approaches. Potentially, certain cells in the cube could guide research in ways that are more interesting because they challenge conventional ways of investigating a phenomenon (Davis 1971). For example, although it may be tempting to portray an ERP transition as a radical form of change, driven by a teleological motor and incorporating theoretical content from economics, the ERP phenomenon may actually be investigated according to other combinations of the dimensions in the framework, which may prove to be more insightful. The framework thus can stimulate creative theoretical thinking about ERP transition.

Finally, the framework can be used to classify ERP transition studies as they are reported and to assist reconciliation of conflicting findings. This task is usually left for reviewers to sort out many years later, but researchers may also acknowledge differences in theoretical foundations as research is conducted. As ERP process research accumulates, therefore, knowledge of the role of ERP in organizational transition should be more intelligible.

In conclusion, although information technology is consistently associated with organizational change, too few studies either use or generate compelling theoretical accounts of the process of technology-based transitions. The rapid emergence of ERP software packages gives a bountiful opportunity to study technologies that seem designed to produce significant changes in organizational processes. The objective of this paper is to represent the diversity of theoretical dimensions underlying organizational change so that researchers will see alternatives to deterministic theoretical logic when studying the transformational potential of some technologies, such as ERP. The proposed framework portrays diverse theoretical choices and stimulates creative thinking about research in this important area.

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