

17 TOWARD A SOCIO-COGNITIVE THEORY OF INFORMATION SYSTEMS: AN ANALYSIS OF KEY PHILOSOPHICAL AND CONCEPTUAL ISSUES

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Abstract

Both the satisfaction of end-user needs and the attainment of organizational objectives have received considerable attention in the information systems literature. Little attention has been paid, however, to reconciling these two facets of best practice at the methodological level. To provide a basis for doing so, this paper proposes a socio-cognitive theory of information systems that reconciles human action and human agency to explain how human and organizational factors in systems development interrelate. Particular attention is paid to the impacts of presented information on learning and action, and the centrality of the selection and organization of information to the nature of organizational forms.

Introduction

A great deal has been written in the academic literature about designing information systems to meet organizational, rather than purely technical, objectives. The design of systems to satisfy the needs of end-users has also received considerable and prolonged attention. Little has been said, however, about the relationship between these two facets of “best practice” and how they might be reconciled at the methodological level. The relationship is clearly fundamental to the success of computer-based information systems given that the value of an organization’s information systems is ultimately realized

through the activities of single end-users or small workgroups. It is argued here that, before such a methodological “synthesis” can be achieved, several philosophical and conceptual issues must be resolved. These issues are discussed and initial progress toward a theory that facilitates consistent and coherent analysis across the multiple socio-cognitive levels is described.

Considering the individual, cognitive science theories of perception, cognition, and problem solving have been applied to human-computer interaction (HCI). The cognitive science analyses at each of these levels, while insightful, tend to be disjoint. The problems of reconciling these levels of analysis have carried over into the HCI literature. Consequently, prescriptive theories and models for HCI design are typically limited in several respects:

- applying sound HCI principles to multiple system components does not guarantee a sound system, while current holistic approaches tend to lack rigor;
- the social environment in which the user is situated tends to be a marginal consideration unless the technological artifacts are actually mediating social interaction; and,
- consequently, the rigorous *ex ante* evaluation of proposed systems is impossible and critical design choices cannot be made with confidence.

In terms of addressing social issues, significant developments have taken place in terms of systems development methodologies. Motivated by interests in industrial democracy as well as more efficient systems, the focus has been upon user involvement as a mechanism for input into the design process. While the contributions of ETHICS (Mumford 1995), SSM (Checkland and Scholes 1990), and other methodologies are extremely valuable, there are two particular issues relating to user involvement that have not been well addressed. First, the communication gap between users, who are experts in their problem domains, and systems professionals remains a serious obstacle to providing an agreed semantics for the data models underlying information systems. Second, involved users can only express their preferences, which are not sufficient in itself to improve design. Individual preferences and organizational needs, however defined, need to be fed into a sound design process that is genuinely capable of taking them into account during the development of the technical artifacts supporting the overall systems design. Such a design process requires a consistent and coherent model that integrates psychological and social factors into the generation and evaluation of potential systems designs.

It is clear from the above comments that, despite operating at different levels, both HCI and systems development methodologies would benefit from a substantive theory able to explain the diverse psychological and social impacts of information and communication technologies (ICTs) and to inform the processes of design and evaluation. The basis of such a theory is the reconciliation of psychological models of human action with sociological conceptions of human agency. Developing an integrated perspective involves addressing several ontological and epistemological issues to provide sound theoretical underpinnings. Initial work to address these issues and provide an integrated perspective is presented here as a socio-cognitive theory of information systems. The ultimate aim is to provide a theory that will underpin models of prescriptive value for the development of technological artifacts and information systems. This aim has influenced the approach to theory development as well as the socio-cognitive theory’s overall character.

Toward a Socio-Cognitive Theory

Zuboff (1988) made extensive use of the contrast between tacit and intellectual skills to describe the impacts of computer systems on worker performance. A similar distinction is made here between tacit and discursive knowledge (Giddens 1984). An additional distinction, of more direct application to understanding ICT impacts, is made between experiential knowledge and presented information. These and other concepts are used here to outline a socio-cognitive model of the individual.

Before outlining the model, a general philosophical point needs to be made. Most of the theory referred to here is rationalistic, reflecting a natural sciences approach to empirical investigation and theory building. Other research is hermeneutic in character. The socio-cognitive theory is based upon neither, adopting a “technological” view of the natural and social sciences. Scientific study is regarded as a specific range of social-psychological activities delimited by intersubjectively agreed standards. Thus, the socio-cognitive theory is tightly coupled to its philosophical position, effectively describing its underlying philosophy as being a special case of its general description. A detailed discussion of this philosophical perspective is beyond the scope of this paper (Hemingway [forthcoming] and Hemingway and Gough [1998] present detailed accounts). Brief explanations are given, however, where the ontological status of phenomena used in the theory requires clarification.

Using Experiential Knowledge

Learning from experience is necessary for successful action in a dynamic environment. Cognitive science has typically explained such learning in terms of three components: perception, cognition, and problem solving (see, for example, Anderson 1990). Since Herbert Simon’s (1956, 1982) seminal work on problem solving, rationalistic analysis, based upon an information processing perspective, has been very influential and continues to play an important role in cognitive science and HCI. A claimed benefit of this approach is that it provides an integrated account of memory, problem solving, and perception (Card, Moran and Newell 1983). The perspective clearly reflects a rationalistic conception of science, regarding perception as an objective and passive means by which descriptions of the environment are derived and made available to working memory (Anderson 1990; Card, Moran and Newell 1983). Cognition takes this psychological equivalent of observation statements and organizes and generalizes them, resulting in “theories” which serve as the basis for prediction and, therefore, action. This view of perception is widely regarded as inadequate, yet the information processing model of cognitive processing remains popular. This sharp distinction between perception and cognition is rejected here as unsuitable for explaining some types of human action, particularly social activity.

The socio-cognitive theory does not regard perception, cognition, and action as readily distinguishable. Stimuli are not passively recorded and passed to working memory, but are considered to be organized relative to an existing structure of knowledge, which reflects past experiences and any physiological aspects of structure (see, for example, Marr 1982). In addition to representing experiences, other associations are formed within memory. There is no fundamental difference between such “pure

mental” aspects of knowledge and those that correspond with direct experience. It is asserted, however, that at least some experiential knowledge is required for meaningful associations to be formed (Hesse 1974). The organization of stimuli relative to existing knowledge is constitutive of meaningful descriptions of the environment. As the environment is dynamic, these experiences will be novel in some respects. Thus, the individual continuously experiences in an informative way; information being defined by *meaning* and *novelty* (see Nauta 1972). While this view might seem to portray experience as a biased activity, which always emphasizes the familiar, this is not strictly the case, because discrimination between memories relies upon the salience of distinguishing characteristics. Thus, while organized experiences facilitate predictive generalization, attention to distinctive attributes permits the identification of particular entities and events.

Having outlined the socio-cognitive theory’s perspective on acquiring experiential knowledge, the organization and use of such knowledge as the basis for action is now considered. Models of the environment must be boundedly transitive because they are based upon groupings according to similarity (Hesse 1974). As the attributes have values, the groupings and, therefore, many models of categorization (e.g., Anderson 1990; Estes 1994) are statistical in character. Most of these models are rationalistic and, as noted by Anderson, pay comparatively little attention to causality and causal attribution. It is suggested here that causal attribution is basic to using memory as the basis for action. Thus, the aim here is not to elaborate upon statistical categorization but to consider whether a statistical account provides a sufficient explanation of human action.

The recognition and categorization of spatial arrangements (i.e., synchronic relations), based upon feature similarity, is reasonably well explained in statistical terms (Anderson 1990; Estes 1994). Cognitive theories often refer to models, but these are prototypes or average cases, and thus convey little more than a statistical analysis of the phenomena with respect to certain attributes. Diachronic relations, extending over time, are more difficult to explain and, it is argued here, require more than statistical analysis based upon observation. One indication of what is additionally required is the importance of learning from experience for the effective attribution of diachronic relations. Such attributions are usefully explained in statistical-causal terms.

Action and agency are not just reliant upon knowledge; they are also prerequisites to learning about certain phenomena, particularly diachronic relations. The individual may experience many co-occurring changes in the environment as a single apparent effect. One way in which the individual can “extract” specific causal relations from this aggregation of changes is to focus upon those, easily identified, changes in the environment arising from his or her own interventions. The effects of these actions can be partially distinguished from other effects by repeated actions on different occasions. Making such causal attributions with respect to one’s own actions is likely to be the most significant means of learning about diachronic relations. It is thus necessary to regard intervention and action in the environment as basic to causal attributions, albeit with a statistical basis.

Individuals also learn about changes in the environment over which they have had no influence. It is suggested here that a key factor in establishing causal attributions to observations is their comparison with existing causal attributions. In other words, diachronic relations can be inferred by developing analogical models. Such a process is

not in any way statistical, although it may serve as a guide to the active search for regularities or similarities. If this claim is accepted as descriptive of individual behavior, then the statistical characteristics of human experience do not provide sufficient explanation and the development of causal models is required as an additional cognitive capability (see, for example, Cartwright 1983). It should be emphasized that these models differ substantially from the statistical averages and prototypes mentioned earlier in that they do not refer directly to experiences.

Drawing upon the structural account of social organization (Giddens 1984), the account of experiential knowledge presented above can be extended to account for some social phenomena. Agency and power are fundamental concepts in social theory, which can be explained in a limited way using the above model of the individual. Agency is the individual's physical intervention in the environment, whether intentional or unintentional. Power represents the ability of the individual to act intentionally to influence states of affairs. These concepts, basic to explaining social activity, closely relate to causal attribution. A causal attribution reflects a *capacity* to change the environment, associated with an expected result of that intervention. In this sense, power is the capacity to intervene in a social environment derived from the learning of physical or social regularities as causal attributions, coupled with the extent of the individual's influence in a given context. Agency is the utilization of this causal "knowledge" of social phenomena to act in the environment. Thus, the statistical-causal model of the socio-cognitive theory can be used as a basis for explaining social activity at the individual level. This is an advance over cognitive science models, which pay little attention to causality or social phenomena. It also differs from the theory of structuration in that it is based upon a psychological model more useful as a basis for technology design than the ego psychology used by Giddens.

Despite the similarities between an individual's learning about physical and social phenomena instantiated in time and space, there is a basic difference that must be noted. Actions based upon learned social regularities are constitutive of the regularities learned (Giddens 1984), albeit in an imperfect way. The individual's conception of the effect causing objects to fall may not be "true" in an epistemological sense, but they have ontological status whether used or not by individuals. The use of knowledge of social regularities, however, is basic to the existence of such regularities. If, for example, businesses opened and closed at random times throughout the day, the social regularity of "normal working hours" would cease to exist. This rather obvious difference is critical to understanding the impacts of technologies on social organization. Where information and communication technologies, for example, substitute direct physical experience for symbolic representation, the phenomena remain unaffected. The individual presented with computer output representing acceleration, rather than measuring acceleration manually, for example, is concerned in both cases with the same phenomena. Where a graph is used in place of general observations of activity in an office as the basis for workload allocation, however, many formal and informal rules relating to allocating, seeking, and avoiding work may undergo substantial change. The nature of such ICT impacts is detailed in the third section of this paper.

Value

So far, the socio-cognitive theory has only addressed the constitution of experiential knowledge, not its application as the basis for action. To explain action, it is also necessary to describe the generation of “strategies for action” and the choice between such strategies where a number of alternatives exist. Economics, decision theory, and cognitive science have addressed these issues through the development of value concepts such as subjective expected utility (Pratt, Raiffa, and Schlaiffer 1995; von Neumann and Morgenstern 1947). Despite significant differences between these notions of value, they have all been developed on a rationalistic, quantitative basis and, consequently, exhibit the following traits:

- a set of criteria *defining* an end-goal;
- the current environmental state, the end-goal, and the set of possible actions leading from the former to the latter define a problem space;
- a preferred course of action is identified by ranking the possible courses of action according to criteria such as probability of success, resource consumption, and time.

Such a description is plainly at odds with the socio-cognitive account outlined above, which would regard these traits as artifacts of rationalistic research and its model of rationality in problem solving and decision making. End-goals are not usually presented to the individual, but are formed through a combination of physiological and psychological factors. Given that the goals will serve as the basis for action, they must be related to the individual’s causal attributions in order to be realized. Specifically, end-goals must be formed through reference to the individual’s knowledge of what can be done and what, in the given situation, he or she has the power and resources to do. Such causal models, as already explained, are developed from experiences of similar events. Associations with knowledge may range from very vague relations with broad categories to the recall of a specific event. Thus, there is no reason why end-goals should be well-defined in order to guide action. Indeed, it is to be expected that goals may initially be very poorly formed, becoming more specific over time.

The notion of problem-space and the evaluation of courses of action are also inconsistent with the socio-cognitive account. In place of these, the organization of experiences of a situation provides information upon which action can be based. Where the experience is of a highly familiar type, novelty will be extremely low and association with a particular past event or range of very similar events will provide a course of action. As noted by Giddens, many day-to-day activities are regularized in this way, such that they become almost automatic, but contextually appropriate, responses. Where novelty increases, appropriate strategies cannot be generated with confidence. Consequently, activity may be directed, using tentative associations made with existing knowledge, toward acquiring information about the present situation, or may proceed according to a low confidence plan, changing as activity progresses and experience of the situation increases. In such situations, tentative modeling of causal relations plays a significant role, with routinized actions being less relevant to the overall activity. Where circumstances are so novel as to have little or no association with existing knowledge, behavior might initially be expected to be almost random, becoming more directed as information is acquired and a causal model of the situation constructed (Anderson 1990).

While the “private” aspects of generating courses of action from experiential knowledge may have little relation to evaluation as conceived by rationalistic theories of cognition, the results of rationalistic research, when considered in light of the research methodology, are of interest when considering the “public” aspects of action. The most simple extension of the “private” model is to consider social interactions for acquiring knowledge from others. Regardless of the nature of such social interaction, at least the following are required:

- communication of the end-goal or motivation;
- communication of the relevant knowledge;
- the location of and interaction with one or more individuals with relevant knowledge.

Privately, the individual would either associate situations with regularized actions or would form causal models relating aspects of the situation to existing knowledge. Such models are based around manipulating the limited power of the individual to directly or indirectly influence the future state of the situation in which he or she is involved. This reference to an intended future implies that the expression of goals during communication is limited to discursive knowledge, whereas motivations/goals are likely to have some tacit component. The individuals acting as sources of knowledge will also associate the expressed motivation with their own tacit knowledge. Thus, the potential for miscommunication and misinterpretation of motivations and goals may limit the effectiveness of any transfer of knowledge.

Unlike motivations, the communication of knowledge and skills arising from past experiences is not restricted to their discursive components. The transfer of tacit skills, however, requires the learning individual to engage in action, and nonlinguistic cues to be available at least to the individual who is conveying the knowledge. Conveying discursive knowledge does not necessitate action, although the meaning acquired by the learning individual will differ from that of the communicator, owing to differences in existing knowledge. The location of an individual to serve as a source of knowledge, unless it occurs by chance, requires some form of social organization. In the context of information systems, the social organizations typically involved are organizational forms, usually firms, which are considered in the next section.

The inclusion, into the socio-cognitive model, of information acquisition through social interaction does not adequately represent the majority of social interactions because the individuals providing knowledge have their own motivations and goals, which affect their social activity. Where individuals have knowledge or skills, they have the power to influence situations in certain ways. Where multiple individuals with independent goals exist, it is possible that intentional actions by one individual to further his or her goals may, intentionally or unintentionally, affect the goals of another. Thus, in contrast to the free provision of knowledge and skill, described in the simplified social relations above, an individual may enable another to further his or her goals on the condition that something relevant to furthering his or her own goals is received in return. Thus, social interaction can be seen to depend upon negotiation in two ways: (1) during the transfer of meaning and (2) during the realization of value or potential value. Expanding upon the point made above, the need for social organization to enable access to requisite knowledge and skills can now be regarded as desirable by individuals because it increases the likelihood of them realizing value in terms of their goals and motives.

A Socio-Cognitive Perspective on Organizations

It was shown above that individuals can and do benefit from negotiated exchanges of skill, power, and resources. Furthermore, the ability to locate individuals with appropriate knowledge and resources requires some form of social organization. Considering individuals attempting to realize their own goals or satisfy their own motivations, identifying appropriate knowledge sources and resources is achieved through communication with others. Given experience of locating people to assist with specific types of situations, the individual will form causal attributions relating to the power/capacity of those encountered. Such knowledge not only supports the individual, but can be used to direct others in their searches. Furthermore, some organization of skills arises from the need for communication to transfer skills and knowledge between individuals. Thus, over time, a network of skilled individuals will arise. Expanding upon this basic social coordination of knowledge, workgroups will form where the need arises for individuals with a certain combination of skills to interact. The shared experiences involved lead to a high level of shared meaning and to experiential knowledge of coordinated action, enabling actions to be taken which are beyond the capability of any single individual.

The basic forms of coordination just outlined provide a reasonable explanation of coalitions of individuals, but not of the social organizations that extend over long periods of time. Those of particular interest in terms of information systems are the organizational forms most commonly associated with firms, namely functional hierarchies, divisional structures and matrix structures. An important point to note in explaining these more complex forms of organization is that they reflect different organizations of the available knowledge. The functional structure is partitioned according to skill and knowledge categories, the divisional structure is partitioned according to types of situations, and matrix structures reflect a combination of skill/knowledge and situation types. Perhaps the most significant characteristic of complex organizational forms, however, is the directed nature of the activities of the individuals and groups that they encapsulate.

An organizational form provides centralization of at least some of the basic elements of value realization and exchange. The centralization of communication and knowledge regarding the capacities and demands for action are the key defining components of organizational forms. The actual transformative capacity, technological artifacts, and resources of transformation often are, but need not be, centralized, as illustrated by the virtual organization. The centralization of value-related information is basic to the directed nature of associated groups and individuals because it makes possible the direction of their experiential knowledge and associated action.

The organization of who experiences and acts in what types of situation makes possible the division of cognitive labor (see, for example, Wegner 1987) and its management to match the capacity of the organization as a whole with the demands placed upon it. This involves internal and external aspects of coordination. Internally, those having control over value-related information can provide individuals and groups with narrow or broad ranges of experiences and may arrange this according to narrow types of activity or to regular types of value-related demand. Furthermore, information of internal and external sources can be utilized to identify and direct opportunities for knowledge transfer that will increase the ability for value realization and exchange. With

respect to the associations external to the organization (note that the boundaries will not be well defined), there is a need to attract types of demands that the organizational form is capable of satisfying. This involves intensive efforts to disseminate information regarding the activities of the organization (e.g., marketing and public relations). It is clear from this overview of organizations that the socio-cognitive theory regards systems and technologies for the communication and storage of information as basic to the reproduction of organizational forms over extended periods of time. Thus, the impacts of ICTs are now considered in detail, first at the individual level and then in terms of the design of organizational information systems.

Presented Information and the Impacts of ICTs

The socio-cognitive model of the individual regards the learning of synchronic and diachronic relations as basic to effective action and regards action as essential to learning, particularly making causal attributions in a dynamic environment. The centrality of situated action to acquiring experiential knowledge implies that the body plays a significant role in the interrelated and continuous processes of learning and acting. Thus, the location of ICTs as media for organizing the interaction between the individual and the situation of action makes the impacts of ICTs fundamental and far-reaching.

Many types of technologies affect experiences along several physiological dimensions (magnification and filtering, for example). ICT artifacts can have similar effects, although achieved via symbolic representation, which must be borne in mind when considering their design. A more significant consequence of using symbolic representations is that presented information can encode attributes of the situation, rather than providing simple transformations of sensory stimuli. Such abstract representations, because they rely upon explicit semantic organization (i.e., data models), provide ways of organizing and selecting the information about the situation that will be conveyed to the individual. Consequently, modes of presentation may be under the control of either the experiencing individual or a person contributing to the construction of the presented information. As discussed later, these aspects of control are crucial to social organization and must be carefully considered during design.

The existence of semantics mediating the experiences and actions of the individual raises two fundamental issues with respect to the individual:

1. how direct experiences and experiences of presented information interrelate;
2. how abstract representations affect the individual's development of synchronic and diachronic relations.

With regard to the first point, direct experience and experience of presented information are distinct and will, therefore, be associated differently in memory. Thus, while experiences of x and y may be categorized together and presentations of x and y categorized together, the direct and presented experiences will be associated only through analogical reasoning. Clearly, this has implications for knowledge transfer, suggesting that the semantics of the data model, at least in some cases, ought to provide as close an analogy to the individual's experiences of situations as possible. The explication of the assumptions and limitations of information systems can also be effectively communicated through the use of analogue and metaphor in user training and interface design (see, for example, Hooper 1986). A significant difficulty here is eliciting semantics from end-users in order to construct data models, given that current

data modeling techniques prove somewhat inaccessible to nonexperts. Initial work to address this difficulty is being conducted (Hemingway and Rollinson 1998). The converse issue of inferring the semantics underlying instances of information presented via an information system is also problematic, relating to the second point of establishing synchronic and diachronic relations.

Synchronic relations are established on the basis of similarity of phenomena in terms of certain attributes. Given that data models (at least using conventional data modeling techniques) encode only well defined attributes, the formation of synchronic relations using presented information will be limited in effectiveness by the degree to which the data model encodes attributes relevant to categorization of the full range of phenomena with which it must deal. Equally important, however, is the ability to discriminate between categories or between instances of categories. With many information systems, the tendency in design has been to achieve such differentiation using arbitrary values, such as customer numbers. While these are technically convenient, they are unlikely to provide significant predictive value and are information-poor replacements for the contextual factors that facilitate discrimination from direct experiences. In other words, the fixed structure reduces novelty (and, therefore, informational content) and makes category-based meaning more specific, but less amenable to change. Having considered synchronic relations, the impact of ICTs on causal attribution is now considered.

Unlike direct experiences of the environment, information systems, perhaps owing to their rationalistic basis, tend to present temporal data as static time series. Such time series, because they are presented in synchronic form, are interpreted as patterns rather than used to develop causal models. In synchronic form, similarity is sufficient and no causal mechanism needs to be established. Thus, when dealing with temporal information, covariation will be sufficient to establish a causal attribution, whereas this is not the case when experiences are in sequential form. For this reason, it is reasonable to expect that the interpretation and use of sequential experiences, whether direct or mediated by ICTs, and the interpretation and use of time series will not lead to the same actions (Anderson 1990; Wortman 1976).

Another key aspect of the temporal nature of experience is that contextual factors in dynamic environments change over time and may, therefore, change what is regarded as appropriate action, even though the problem is nominally the same. With a fixed data model, such context is largely lost and the feedback that makes effective causal attribution and action feasible is more difficult to provide. Action thus becomes somewhat inert, distanced from both its context and consequences.

Implications for Information Systems Design

The importance of establishing meaning through experience and action and the impacts of ICTs upon them have been the key themes of this paper. It has been noted that shared meanings and knowledge of others' skills and knowledge are vital to effective social organization, and that they must be accounted for in the design of information presentations and information systems in general. Several implications of the socio-cognitive theory can be made at this early stage in its development. First, effective IS design is heavily reliant upon the provision of means for eliciting and reconciling the semantics of nontechnical users in order to develop a data model. Methods of inferring general semantics from the information artifacts already familiar to users should, therefore, improve the ease of requirements specification and data modeling. Second,

interfaces should be designed to enable the semantics and assumptions of the underlying data model to be readily inferred. Caution must be taken with regard to this recommendation, however, because users without direct experiential knowledge will acquire experiential knowledge of the information system without questioning its underlying assumptions. Such unquestioning use of a system does not imply effective decision making and action, even though the user may not find their activities problematic. Third, the information system needs to support the socio-cognitive processes involved in developing shared meanings. This suggestion is consistent with the recommendations of researchers in group support systems, who advise that such systems should support the negotiation of shared categories (Wilson and Canter 1993). Fourth, and following from the caveat to the second recommendation, individuals will benefit from work roles that include some opportunities to gain direct experiential knowledge. Such job design will make less likely the unquestioning acceptance of the assumptions of the information system by providing some experience of the typical situations encountered. Finally, the socio-cognitive approach suggests that dynamic environments might more suitably be addressed if end-users, without expert knowledge of systems development, were able to adapt the system's semantics (i.e., data model and interface) in accordance with developments in the environment. Such end-user oriented technologies must support complex social processes of negotiation so that similarities and differences in the meanings attributed to situations by different types of users can be accommodated. More detailed recommendations in this regard are presented in Hemingway and Rollinson (1998).

Conclusions and Future Work

Developed into a more substantial form, the socio-cognitive theory has the potential to make a significant contribution to the understanding of a number of core IS research issues. In particular, its reconciliation of individual action and agency provide the basis for integrating the cognitive aspects of designing systems components with the social issues addressed by systems development methodologies. Current research by the author and a colleague utilizes the theory to inform the development of tools to support end-user systems design. This research pays particular attention to the alignment of the semantic organization of information systems with the characteristics of effective action based upon experiential knowledge. Another strand of research contributing to the development of the theory is the examination of formal and informal processes of evaluating information systems. This research aims to further develop the value concepts outlined here. Over the long term, rigorous empirical study based upon a methodology aligned with the philosophical position underpinning the socio-cognitive perspective is also required and may prove fruitful both theoretically and for informing IS practice.

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