Affordance Theory and How to Use it in IS Research
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Abstract

In this chapter we provide an overview of Affordance Theory, and provide guidance to IS researchers on how to use it properly and productively in their research. We start by examining the core features of Gibson's original theory and considering some of the challenges we encounter when translating it from ecological psychology to IS. We then distill these observations into six principles for appropriately applying an affordance lens for IS research, after which we discuss three unresolved issues and our views on how these might be addressed. The chapter then comments on the critical realist underpinnings of affordance theory, and how researchers who are not critical realists might utilize an affordance lens nonetheless. It concludes by identifying research opportunities enabled by the application of an affordance lens, and the observation that by finally having a tool that allows us to include the IT artifact appropriately, our theories become of real value to practitioners.

Nothing is so practical as a good theory – Kurt Lewin

When Andrew van de Ven (1989) used Lewin's quote as the title for his editorial comments regarding theory in organizational research, he was probably not thinking about Affordance Theory. It would, however, have been a very apt example. As various articles in that special issue of AMR argue, the key to good theory requires not just that we identify key constructs and describe how they are related, but that those constructs and the relationships among them help us explain real world issues. Good theory should help us explicate the generative mechanisms that underlie the phenomena we observe and want to understand (Tsoukas, 1989). Affordance Theory provides building blocks for such explanations that both explicitly incorporate the IT artifact into the analysis and are well aligned with the way practitioners who are deploying and using IT think about the challenges they face.

Not surprisingly, interest in Affordance Theory has surged among IS researchers. While there have been some growing pains during the developmental process of translating this theory from its original domain of ecological psychology to IS, including inconsistent definitions of constructs and sloppy use of terms, the enthusiasm has been rewarded with interesting and useful findings. In this chapter we aim to bring clarity to the discussion by providing clear definitions and guidelines for researchers. We also examine some of the interesting directions that have been explored to date and several thorny issues that have arisen, and highlight several questions that remain open as we move forward.

Origins of Affordance Theory

The IS literature already has many excellent overviews of the history of Affordance Theory (e.g., see Fayard and Weeks, 2014; Majchrzak and Markus, 2012; Markus and Silver, 2008; Robey et al., 2013; Zammuto et al., 2007 among others). Rather than repeat that material

here, we provide a short overview, drawing out some specific elements that relate to the guidelines we propose for using Affordance Theory in IS research.

Gibson (1977, 1979) articulated the original tenets of Affordance Theory to express his view that a goal-directed actor perceives an object in the environment in terms of how it can be used (what it "affords" the actor in terms of action possibilities for meeting that goal), and not as a set of characteristics or features that are inherent to the object and independent of the actor. Furthermore, these affordances are perceived directly (if they are perceived), not requiring cognitive analysis of object characteristics and features. They also exist independently of whether the actor perceives them or not. Thus a chair affords an adult human the possibility of sitting (if he or she wants to) and does not depend on that person consciously analyzing the chair's height, stability or solidity. Similarly, an email system affords a user who has appropriate capabilities the possibility of communicating.

Subsequent to Gibson's original work, a debate ensued among ecological psychologists to clarify various ontological issues. While Turvey (1992) considered affordances to be a property of the environment, paired with and relative to actors who have the capability to actualize those affordances, Stoffregen (2003, p. 123) argued that affordances do not exist in the objects or the environment alone, but "are relational (i.e., emergent) properties of the animal-environment system." Chemero (2003) disagreed that affordances are properties of the relationship, and defined them as the relations themselves between particular aspects of animals and particular aspects of situations. Within a few years, these different authors converged on a shared understanding. In a joint article, Chemero and Turvey (2007) wrote that "both Turvey and Chemero understand their views of affordances as claiming that affordances are emergent, relational properties of animal-environment systems" and presented a united front to oppose those who defined affordances as mental representations, arguing that such views directly contradicted Gibson's intention.

Before this debate was resolved, researchers in other fields started to adopt the notion of affordances with the inevitable result that the term has been used in contradictory ways. Fortunately, some dominant themes are appearing. A main theme in technology-related fields mirrors the Chemero and Turvey perspective noted above that affordances arise from the relation between users and technology (and are not of the technology itself). Another theme is that affordances relate to action possibilities for goal-directed actors, not to actual actions, and also not to objects or states. This latter distinction, however, has often been blurred in the IS literature, as will be discussed later.

Before turning to our discussion of the issues involved with using Affordance Theory in IS research, we briefly explore one of the main alternative uses of Affordance Theory in technology-related literature, namely its application to the design of everyday objects and its resultant use in human-computer interaction studies, as inspired by Norman (1988). As opposed to the view that affordances are "real", existing apart from the actor's perception, but arising from the relation between the object and the actor (i.e., the view of Chemero, 2003; Robey et al., 2012; and the view subscribed to in this chapter), Norman (1988) used the term to refer to both perceived and actual properties of an object, without reference to an associated actor. While even in this original use Norman acknowledged his deviation from Gibson, some years later he

publicly regretted his use of the term, as it had taken on several new and sometimes inappropriate meanings. Specifically, Norman (1999) points out the differences across three related but separate elements, namely (a) an affordance, (b) an actor's perception of that affordance (where the two may or may not coincide), and (c) the visual feedback or information the object supplies to suggest an affordance. Interface designers are interested in ensuring that the visual feedback available, (c), helps ensure that the other two, (a and b), are in sync. HCI research is about how to make that happen. One helpful distinction is to recognize that the HCI/Norman view of affordances relates to the usability of an object, whereas the original Gibsonian view relates to its usefulness (McGrenere and Ho, 2000). This latter, functional perspective focuses on what the potential actions afforded by the technology-user relationship are intended to accomplish, rather than the details of those actions in any particular situation. We now turn to this functional perspective, that is, to Gibson's original view, and its application to IS research.

Adapting Affordance Theory for IS Research

Among the perennial topics in IS research is the exploration of how technology is selected and used, either by individuals or groups of organizational actors, and the resulting changes in organizational processes and structures. An ongoing challenge in this work has been to adequately acknowledge the materiality of technology while avoiding the two extremes of technological determinism and social contructivism (Leonardi and Barley, 2010; Robey et al., 2012). Affordance Theory takes a socio-technical perspective that lets us be specific about the technology while simultaneously incorporating social and contextual elements. Over the past decade, these possibilities offered by traditional Gibsonian Affordance Theory have been recognized and calls made to employ it in our work (Markus and Silver, 2008; Zammuto et al., 2007). Those calls have been answered by many researchers who have made interesting and useful discoveries.

As mentioned above, early writers in this area focused on introducing and examining Affordance Theory itself by looking at its origins and what it promises the IS field. Subsequently there were a variety of second order reflections on the use of Affordance Theory in IS research. For example, the transition from individual to organizational use of artifacts required not only a new definition of affordances with implications for theory building (Strong et al., 2014) and a discussion of underlying ontology (Volkoff and Strong, 2013), but also an introduction of new constructs, such as consideration of shared and collective affordances (Leonardi, 2013), and new methodologies, such as using an affordance approach to support computational analysis of routines (Gaskin et al., 2014).

Where Affordance Theory really becomes useful, however, is when we start utilizing it as a lens for changing how we look at a variety of IS topics rather than simply examining the theory itself. One theme that has emerged is a fresh look at the familiar topic of IS adoption, adaptation, and organizational change. For example, Leonardi (2011) uses an affordance lens to build his theory of imbrication to explain adaptations users make either to routines or to the technology they use. In contrast to examining emergent change as per Leonardi, Seidel et al. (2013) used an affordance lens to understand how technology might proactively support a desired change, in their case to change business practices to be more environmentally sustainable. More recently

Glowalla et al. (2014) used an affordance lens to examine differences in how organizations appropriate business intelligence software.

Within this general theme of organizational change viewed through an affordance lens, the study of organizational routines has emerged as an interesting subtheme (Robey et al., 2012). Examples include looking at a health information system implementation in a hospital (Goh et al., 2011), at the relationship between mobile apps and routines (Boillat et al., 2015) and a process of looking at networks of actualized affordances to analyze routines (Pentland et al., 2015).

One specific domain where the affordance lens has been used productively is the adoption and use of social media. For example, Treem and Leonardi (2013) examined how social media use within organizations can affect such processes as socialization, knowledge sharing, and the exercise of power. Majchrzak et al. (2013) show how four different affordances associated with the use of social media to support knowledge sharing induce a shift from a process that is centralized, intermittent and repository-based to a set of continuous online communal knowledge conversations that are decentralized, continuous and emergent. Jung and Lyytinen (2014) provide an "ecological account" of media choices made by users, i.e., one that is grounded simultaneously in the materiality of each medium and social interaction factors.

Another specific domain has been the use of an affordance lens to look at software development. For example, van Osch and Mendelson (2011) looked at users and developers as they used various tools, from which they developed a typology of affordances as designed, improvised or emergent. More recently Krancher and Luther (2015) employed an affordance lens to explain how the use of platform-as-a-service changes the work of software development teams.

Unfortunately, while there have been many valuable contributions based on Affordance Theory, it has also been used in ways that are inconsistent with each other, and that furthermore contradict Gibson's original intention. These concerns apply even to some of the otherwise notable examples given above. Furthermore, the theory has, to some extent, become the "flavour of the month". As a result, Affordance Theory is included in many papers (whether of value or not) and anything and everything related to IT artifacts is being labelled an affordance.

One reason for the confusion about how to use Affordance Theory in IS research has been the challenge of translating Affordance Theory from its origins as an examination of individual actors engaging with individual objects to a study of groups of organizational actors engaging with complex, somewhat opaque objects, namely information systems. This has required a number of extensions to the original theory. For example, Strong et al. (2014), wanting to study the implementation of an electronic health record system in a multi-site medical group, found they had to address three key issues in using Affordance Theory.

First, while they determined that Affordance Theory provided a useful lens, its originators had focused on a different type of question, namely how an actor sees an object in the environment, but not what happens when, after seeing it, that actor engages with it to do something. While the possibilities for action are important in IS research, so are the actual actions taken and the outcomes of those actions. Thus Strong et al. found they had to distinguish clearly between the

affordance itself (the possibilities for goal-directed action), its actualization (the actions actually taken), and the outcomes of those actions.

Second, while at any given moment it is an individual that engages with the technology, that individual is part of various organizational structures, from local work groups engaged in collective tasks, to the far-flung multi-level hierarchy that is the modern organization. This introduces a problem, namely that while an affordance relates to a goal-directed actor, we still need to know, "which or whose goal"? Not only does each actor have many goals, from personal goals to task-related goals, but he or she is also subject to group and organizational goals. Strong et al.'s approach was to focus, not on overarching goals, but rather on immediate concrete outcomes of the task being executed during the affordance actualization process.

Third, not only are there multiple actors using a complex object, but there are multiple affordances, what we call bundles of affordances (Strong et al., 2014), arising from any object-actor relation. Thus actualizing an affordance does not happen in a vacuum, and we need to consider the bundles of affordances and the ways these affordances interact.

With all these issues in mind, Strong et al. (2014) proposed a definition for the word "affordance" to accommodate the nature of affordances in organizations:
> ***An affordance is*** the potential for behaviors associated with achieving an immediate concrete outcome and arising from the relation between an artifact and a goal-oriented actor or actors.

Six Principles for Using Affordance Theory in IS Research

Several key points flow from the above definition of affordances and the analysis that led up to it. We articulate these points as six principles for using Affordance Theory in IS research (Strong and Volkoff, 2016).

Principle 1: Remember that an Affordance arises from the user/artifact relation, not just from the artifact.

While already discussed several times, it is important to remember that affordances arise from the relation between the technology and the actor. It is very easy for authors writing about affordances to slip into language and arguments that treat affordances as though they are the same as features of the technology. A technical artifact does not have any affordances except in relation to a goal-directed actor. That said, it does not have to be a specific actor (until we move to actualization), but can be thought of as an archetypal actor with a set of defined tasks related to a specific goal.

Principle 2: Maintain the distinction between an Affordance and its Actualization.

The definition above highlights the critical distinction between an affordance and its actualization. The affordance, as the potential for action with respect to an actor's goals, refers to function (what the affordance is useful for or the purpose of the action), i.e., an affordance is the potential for achieving a goal. As such its definition will be somewhat abstract and applies across potential actors with that goal and associated capabilities. The actualization, as the action itself, is specific and relates to structure, not function, where structure focuses not on the purpose

of the action, but the actual configuration of behaviours that make up the action (Burton-Jones and Gallivan, 2007; Morgeson and Hofmann, 1999). Thus, while affordances relate to potential actions and the purpose they are intended to achieve, actualization relates to a particular individual actor and details regarding the specific actions that actor will take or has taken.

Principle 3: Focus on the action, not the state or condition reached after taking the action.
An affordance is about potential action, not about the state or condition that is reached after an action is taken. The immediate concrete outcome is the state reached after an affordance has been actualized. The problem is that when we focus on the state or condition reached, the research differs little from IS impacts research, and in particular, can lose sight of the need to understand the role of technology and user actions, i.e., the mechanisms involved that provide the explanatory power that is a core contribution of using Affordance Theory. To accomplish this focus, it helps to be careful in our naming conventions for affordances by using a verb participle, such as "sitting" or "communicating", reserving noun forms for the immediate concrete outcome that results.

Principle 4: Select an appropriate level(s) of granularity for the affordances.
The definition of an affordance says nothing about the level of granularity that is appropriate, other than that it relates to an actor or actors who are capable of action and an artifact with various features. In fact, Gibson makes it clear that in his view affordances are nested. He uses the example that at one level an apple affords a human the possibility of eating, but that this is composed of lower level affordances such as biting, chewing and swallowing. Similarly, an individual using an email system is afforded not only the possibility of communicating, but also the possibility of first composing and then sending a message.

The appropriate level of analysis is dictated by the question at hand. Of course just as an affordance can be decomposed into lower level affordances, affordances can also be aggregated into higher level, and generally more abstract, affordances.

It is often at this more abstract level where the distinction between action potential and state or outcome (Principle 3) becomes somewhat blurred. Thus, for example, our literature contains many references to a "visibility" affordance. This is, however, a state, and masks the associated actions – and even the actor. Visibility is associated with two types of actors, the provider of the information, and the receiver. The former, by "inputting data", might, in the course of "making information visible" be engaging in various activities, from, "revealing information" (sometimes inadvertently), "telling" (deliberately), or "promoting" (actively). Similarly, the receiver, by "accessing data", may be "observing", "monitoring", or "investigating". The outcome "visibility" might be the subject of many interesting research questions. The power of the Affordance lens is that it helps to pinpoint the actors involved and the variety of potential actions they might engage in as they use the technology. Actualizing those affordances results in a particular outcome, namely visibility.

Principle 5: Identify all salient affordances and how they interact.
In addition to the affordances that are nested within any affordance, there are many other affordances available arising from the relation between the technical artifact and the actors. These are not independent, but rather interact. Unlike Gibson, we are generally not interested in

a single affordance, but in the bundles of affordances that arise from the many potential uses of an IT artifact. Often, more sophisticated affordances (such as monitoring) depend on successful actualization of more basic affordances (such as inputting data), generating a dependence network of affordances (Strong et al., 2014). Affordances may support other affordances or may interfere with them, generating a number of interesting research questions. Again, the identification of which affordances to focus on depends on the research question being asked.

Principle 6: Recognize social forces that affect affordance actualization.
Affordances are not actualized in a vacuum, but rather in a social context. Thus, social forces, arising from the groups within which the actors operate, also affect how, how well, or even whether any affordance will be actualized. In addition to analyzing traditional social mechanisms such as group or cultural norms that can enhance or constrain the actualization of an affordance (Bloomfield et al., 2010), we need to consider how the presence of other people using the same artifact for similar or related purposes will affect an actor's behaviour.

One way to do this is to use Leonardi's (2013) differentiation among individual, shared, and collective affordances. An individual affordance is actualized by one actor acting independently of others; a shared affordance is the same affordance being actualized by many people in similar ways; while a collective affordance involves many people doing different things to accomplish a joint goal. For IT artifacts used in an organizational context, the concepts of shared and collective affordances are important. As computing becomes more ubiquitous, IS researchers are also interested in individual affordances, e.g., for individual healthcare support apps. In all three cases, IS researchers are likely to be more interested in the bundles of affordances available to users, often across more than one IT artifact, than in investigating a single affordance.

Unresolved issues

The six principles above are fairly straightforward, and if followed consistently with rare violations, they can go a long way toward removing the confusion and inconsistencies that can occur when IS researchers apply Affordance Theory without due consideration. There remain, however, some unresolved, vexing questions for researchers applying an Affordance lens to IS research.

Issue 1: Do affordances have to be perceived to be actualized?
The first of these issues is the various views that have been expressed regarding what it means to "perceive" an affordance, and whether affordances must be perceived to be actualized. Part of the issue is how the word "perceived" is defined in the first place. When Gibson introduced Affordance Theory, his whole purpose was to understand how actors perceive objects in the environment; that is, Affordance Theory is a theory about and redefinition of perception. His insight was that actors, in general, do not process what they see through cognitive filters, but rather that they process the information in a more intuitive manner, focusing on affordances. What he also said, however, is that affordances do not need to be perceived to be actualized.

This leads to two points. The first is that the construct "perception" needs to be carefully defined before being used. At present it is used to cover everything from mindful, cognitive awareness through practical or physical awareness, to subliminal or intuitive awareness. While all of these

are legitimate possibilities, Gibson's whole argument is that the first form is not the way we generally operate. Thus an actor wanting a drink of water will automatically, and with little or no thought, reach for a cup, not a fork.

The second point is that an actor may actualize an affordance without being aware of its existence at all, not even at an intuitive level. This is particularly true when the artifact in question is complex and somewhat opaque, such as an information system. For example, a person using a technology such as Facebook, who is deliberately actualizing a "communicating" affordance by posting something for his or her friends to see is often simultaneously actualizing a "broadcasting" affordance whereby unknown others also have access to the information (for example if it gets commented on or tagged by someone and so ends up appearing in other places). A similar situation arises when the user of an enterprise system enters data - actualizes a "data inputting" affordance. That actor may not be as aware of actualizing the associated "broadcasting" affordance, which in turn triggers or enables additional affordances, such as a "monitoring" affordance, for other actors such as managers.

Of course, while an actor does not "need" to perceive an affordance to actualize it, it may well be that mindful actualization makes the user of an artifact more effective. This leads to a variety of interesting research questions regarding threshold levels of awareness needed for effective use, or the types of affordances for which unintentional actualization is more likely to occur. Similarly, such an analysis may help to explain or prevent unexpected outcomes.

Given the above concerns, the term "perceived affordances" should be avoided. It introduces confusion because Gibson's Theory is already a theory of perception and because the concept of "perceived" means many things. As such, the term "level of awareness" of an affordance may provide better terminology than referring to "perceived affordances."

Issue 2: Are affordances both enabling and constraining or only enabling?
A different question relates to whether affordances can be both enabling and constraining, or whether affordances are only enabling, and constraints are different. Certainly our literature has examples of both perspectives. In support of the "just enablement" view, it could be argued that the plain language meaning of the word "affording" refers to enablement. In addition, it seems unlikely that an actor would deliberately actualize an affordance that constrained his or her actions.

Hutchby (2001), one of the earlier researchers to apply Affordance Theory to technology, used it to argue that technical objects cannot be viewed simply as "texts" that are read and interpreted by users with complete flexibility. Although an individual's interpretations and social processes do influence how such objects are used, technical objects also have material properties that both enable and constrain users while not determining what those users will do, nor what the outcomes of use of such an object will be. What is not clear from his work is whether the associated affordances embody both enablement and constraint, or only the former. The case for both enablement and constraint is made clearer by Zammuto et al. (2007, p. 752, when they state that "An affordance perspective recognizes how the materiality of an object favors, shapes, or invites, and at the same time constrains, a set of specific uses."

Like Zammuto et al., we argue that affordances embody both enablement and constraint; i.e., like most things, affordances are often two-edged swords. When one thing is enabled, something else is simultaneously constrained, simply because the two are incompatible, and the enabling and constraining aspects are not separable. Thus a locking mechanism on a door affords an actor a barricading affordance, which might be seen as enabling if the actor's goal is privacy or protection, but would also be seen as constraining by preventing that individual from escaping if threatened. Similarly, using an enterprise system to actualize a data inputting affordance enables an actor to record the day's activities (which may be required for payment of wages) but simultaneously constrains the same actor from hiding the long lunch hour taken. It is because of this two-sided nature that we subscribe to the "affordances as both enabling and constraining" point of view. This also aligns with Gibson's original views on this topic.

Issue 3: How "capable" does an actor have to be for an affordance to apply?
    Finally, Affordance Theory implies that the actor involved is "capable" of actualizing the associated affordance. The question that arises is whether this means "physically capable" (i.e., has the manual dexterity and strength required) or whether it also demands knowledge of how to execute the action. Gibson mostly considered simple everyday objects such as rocks or stairs where physical ability mattered, but skill per se did not.

When we are confronted with a new system on which we have not yet been trained, are there any affordances? One answer might be "no" because we may have insufficient knowledge to have any sense of potential actions we might take or of the likely outcomes of such actions. In our view the answer is "yes", in large part because knowledge is not a binary characteristic, but rather an emerging and ever-changing one. An actor might actualize an affordance ineffectively to start with, but over time and with training their skill level will increase. In the same way that affordances exist whether or not an actor is aware of them, we contend that the affordance as a theoretical "potential for action" exists whether or not the knowledge for how to actualize it has been acquired yet, as long as the physical capacity is there. Among other benefits, this perspective makes it easier to ask questions related to training and its outcomes.

Consistency of Affordance Theory with Underlying Philosophical Perspectives

    In our discussion to this point, we have not explicitly addressed the question of which underlying philosophical perspectives fit best with Affordance Theory. Specifically, Affordance Theory, like any theory, has underlying ontological assumptions about the nature of reality and underlying epistemological assumptions about what we can know. These assumptions can be more or less consistent with various philosophical perspectives and research methods typically used by IS researchers. Thus, we examine how Affordance Theory fits with the philosophical perspectives used by IS researchers.

Although Gibson does not state his philosophical orientation, others have described the critical realist nature of ecological psychology in general, and Gibson in particular (Markus and Silver, 2008; Michaels, 2003; Volkoff and Strong, 2013). Ontologically, critical realists assert the existence of an objective reality separate from us (and that includes both the physical world, and the non-physical, such as social structures). Epistemologically, they assert this reality is unknowable because researchers view it through their existing knowledge and biases.

Furthermore, researchers can only view empirically observable events, a subset of all actual events. They cannot directly view the generative mechanisms that cause actual events, nor the elements within the objective reality, and the relations between them, from which the generative mechanisms arise (O'Mahoney and Vincent, 2014; Mingers, 2004). From their observations of events, researchers can, however, retroduce what those mechanisms must be. Stating that affordances exist whether or not an actor is aware of them or not indicates an underlying realist perspective – affordances are real and while they exist in relation to the actor, they do not exist only in the mind of the actor. The extent to which the actor is aware of them (if at all) will affect the actualization, but not the existence of the affordance.

Assuming the IS researcher wanting to utilize Affordance Theory is a critical realist, what does it mean for the research itself and the way it is conducted? For those of us who are critical realists, the objective of doing research is to identify the underlying mechanisms that generate the phenomena we want to understand. Those mechanisms are not deterministic, so the goal is not to predict outcomes, but to explain them. The better we understand the bundle of affordances at play in a situation – both what they are and how they interact – the better we are able to understand events as they unfold and likely directions going forward. That said, Affordance Theory is not the explanation itself, but rather provides a new way of seeing things that makes identifying the mechanisms easier.

For the many IS researchers who are not critical realists or who focus on research questions that are not seeking to find explanatory mechanisms, Affordance Theory can also be useful, as long as we appreciate the underlying philosophical assumptions. For example, those of us taking a positivist perspective and aiming to build causal models hold ontological views similar to critical realists, namely that an objective reality exists, separate from us. Where these two camps diverge is over epistemology, as positivists believe reality is knowable, and hence our research should focus on that which we can see and measure in order to test theoretical propositions. Positivists will find that Affordance Theory does not directly generate predictions that can be tested. First, because they are potentials for action that users may not even be aware of, and in any case may never actualize, affordances cannot be treated as measurable constructs. Second, affordance actualization captures a non-deterministic process guided by various users' goals, thus lacking the causality needed for predicting actualization outcomes.

That said, the real nature of affordances is aligned with a positivist perspective. By using Affordance Theory as a lens for thinking about the interactions between a technical artifact and users, we can ask questions that would be amenable to developing and testing causal models. For example, as mentioned above, we might explore the extent to which mindful actualization mattered more for some affordances than others, a question that can be examined empirically. The key would be first to understand the bundle of affordances and how they interact well enough to see where actualization without mindfulness inhibits effective use of a system. Similarly, issues of training – what to train on and how to design training – can be explored once the bundle of affordances is identified. Identifying the bundle of affordances, however, is easier after actualization, but even then, some affordances may still not be recognized or may only be recognized and actualized by a few of the many users.

While not often articulated (for exceptions see Carlsson, 2010; Gregg et al., 2001; Purao, 2013), the ontology of design science focuses on a reality that has not yet been created, although, like positivism and critical realism, it accepts that this reality exists separate from us once created. The difference between design science and positivism is that while the latter focuses on understanding relationships as they are, design science focuses on what reality might look like in the future – and recognizes that the outcome is not preordained. Indeed, both the products of design and the design process itself evolve. As with critical realism, then, design science has a focus on the mechanisms underlying the process. For that reason, Affordance Theory should serve an IS researcher taking a design science approach extremely well. By identifying potential affordances, both those that are explicitly designed and those that emerge, arising because of interactions or even unintended uses, our designs can be improved. In fact, affordances are similar in many ways to use case scenarios.

While Affordance Theory is, in general, a useful lens, it seems less appropriate for use by those of us who are pure interpretivists, as we would be less comfortable with the notion of affordances being real and existing whether or not they are recognized. What Affordance Theory does offer is an inexorable connection between the social and the technical. Affordances do not exist in either the artifact or the user – they are of the relation between the two. The difference between this view and pure sociomateriality is that even in the relation the social and the material are held apart – they are not so intermingled as to be indistinguishable, just as the two strands that comprise the double helix of a DNA molecule are both integral to that molecule yet remain separate. In this sense, Affordance Theory provides a lens consistent with the perspective of those of us who prefer a socio-technical perspective.

Conducting IS Research Using an Affordance Theory Lens

Affordance Theory, used correctly (i.e., following the six principles above), provides a variety of research opportunities for IS researchers to be specific about the technology while also incorporating the social context. In this section, we highlight a few of those opportunities.

Before doing so, we note two caveats. First, when thinking about using Affordance Theory, IS researchers should consider the underlying philosophical perspective they are using to be sure Affordance Theory provides an appropriate and consistent lens for their research. Second, IS researchers should consider whether and how Affordance Theory adds value to a study. Affordance Theory provides IS researchers with many new opportunities, but it is not a good fit for every study, nor is it a replacement for the many different approaches we already have for conducting excellent IS research.

For IS researchers, Affordance Theory, although a theory itself, provides a lens for developing a variety of mid-level social-technical theories. That is, using Affordance Theory in IS research is not simply an application of an existing theory, but rather is a new way of thinking about the artifact/user relationship that can be useful for generating new socio-technical theories. Those new theories are necessarily mid-level rather than grand theories because they are grounded in specific technologies and users.

One area of IS research opportunity is identifying affordances. When we study affordances, we can connect them to artifacts at various levels – from the broad system level such as "an enterprise system" to a feature level such as different types of input media. Generalizability is not to all technology (which makes the artifact vanish), but rather to common functional aspects of a type of technology. Enterprise systems are different from each other, but they are even more different from gaming platforms. There will be generalizations we can make about the former once we understand how the features that are common to enterprise systems are implicated in affordances with typical enterprise system users. Similarly, we can explore various affordances arising from actors engaging with different social media. We can also compare affordances across technology and user types as Volkoff and Strong (2013) did in their re-analysis of their enterprise systems study and Leonardi's engineering support systems study. We can generate useful knowledge by developing theory around affordances and their connections to technology features and to user characteristics, goals, and capabilities. For example, connecting affordances to associated technology features can help us better understand and conceptualize the IT artifact, which in turn can help us create better IT artifact designs. Similarly, by connecting affordances to associated user characteristics, goals, and capabilities, we can design artifacts that are easier to use, and also can better understand training needs and create better training materials.

When identifying affordances, we must remember that an IT artifact provides multiple affordances, that is, bundles of affordances, to users, and these affordances are interconnected and interdependent in various ways. These connections and interdependencies can be studied. For example, Strong et al. (2014) proposed studying temporal networks of affordance dependencies, focusing on the sequence in which affordances could be actualized because the actualization of some affordances depend on previous actualization of other affordances. Lindberg et al. (2014) proposes studying the ecology or configuration of affordances across multiple IT artifacts because in practice users are choosing to actualize multiple affordances available from multiple IT artifacts simultaneously.

Another area of IS research opportunity focuses more on affordance actualization and seeks to identify mechanisms for organizational change. Focusing on actualization provides the foundation for our ultimate goal of increasing our understanding of the resulting changes in organizations as affordances are actualized. In doing so, we can provide practical insights to managers attempting to effect change through effective use of technologies. Using the Affordance Theory lens, we explicitly acknowledge that technology does not determine effects, but also that there is the possibility of guiding the actualization process so that desired effects are more likely and unintended consequences are recognized and managed. With a focus on actualization, we can build mid-range theories of IT implementation and IT-enabled organizational change that focus on specific technologies and specific organizational goals.

An emerging opportunity is to use more quantitative techniques to study affordances and their actualization. For example, as we think of bundles of affordances and their actualizations in terms of networks, sequences, or configurations of these affordances, we could employ various network analysis tools to analyze and understand those configurations. Furthermore, since actualizing many of the affordances of interest to IS researchers typically involves using an IT artifact, that usage can be tracked, enabling associated "market basket" analysis of which artifact features are used together (Lindberg et al., 2014). While feature use is not the same as an

affordance actualization, one can track who the user was and perhaps develop an understanding of the user goals.

Finally, although early IS researchers using Affordance Theory have done much to adapt Affordance Theory to the IS research context, there are still unresolved issues as noted above. We expect that, as IS researchers continue to use Affordance Theory, adaptations will continue to evolve to capture how Affordance Theory can be best used across the many research perspectives that underlie IS research.

Conclusion

Affordance Theory's focus on the relation between the IT artifact and users, while also maintaining the distinction between them, is what allows us to bring the IT artifact back into our research. Through Affordance theory we finally have a way to be specific about the technology while incorporating the social context in mid-range socio-technical theories. To do so, we must focus on mid-range theories to avoid generalizing so much that we lose the artifact again.

As noted in the opening quote by Lewin, good theory can provide practical guidance to managers as they try to address real-world issues. Managers need actionable suggestions, and can become frustrated when presented with abstract notions that are often largely self-evident. Research employing Affordance Theory can provide useful guidance in many ways, enabling IS researchers to provide research results of relevance to managers. For example, simply identifying individual affordances enables managers to ensure system users are aware of the possibilities presented by a given technology. Conscious articulation of the expected outcomes associated with these affordances supports analysis of whether users are actualizing the affordances effectively. Identifying bundles of affordances and their dependencies can help explain how interdependencies generate blockages for achieving expected benefits, or highlight external factors that might interfere with actualization. Similarly, surfacing unrecognized affordances may explain unexpected and unintended outcomes. Such analyses can also improve how groups of users jointly actualize either shared or collective affordances.

Finally, the affordance lens enables improvements to the design of IT artifacts and the work practices surrounding those artifacts, as we better understand the bundles of affordances and their interactions that IT artifacts provide to capable users. Overall, Affordance Theory – if appropriately employed – allows researchers to create for managers a new set of levers for solving practical problems.

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