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Innate Principles and the Digital Object: Insights from Core Knowledge Theory

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Abstract

Psychology research reveals that humans possess innate principles that govern how we make sense of objects and object-directed actions. These principles are embedded in interrelated systems of core knowledge that shape behavior. This paper theorizes how the innate principles embedded in two core knowledge systems—the system of object representation and the agent system—play a crucial role in shaping how a technology user conceives of and carries out an object-directed action through a digital object and its embedded features. The theorization is instantiated in the context of IS research through a framework we call the user-object action scene, which comprises four interrelated elements: the user, the goal-object/goal-agent, the object-approach, and the goal environment. We conclude by encouraging IS researchers to revisit established IS theories through the lens of innate principles, and provide guidance on how to use innate principles to reexamine two IS theories: technology acceptance and technostress.

Keywords: digital objects, digital agents, IS theory, innate principles, core knowledge

1. Introduction

Questions concerning how humans make sense of objects have been debated for centuries (Baillargeon and Carey, 2012; Bloom, 2005; Spelke, 1988). For example, rationalist philosophers, such as Plato, Descartes, and Kant, reason that humans possess innate principles, meta-physical in origin, that guide how we perceive objects and expect objects to behave (Baillargeon and Carey, 2012; Bloom, 2005).

Alternatively, empiricist philosophers, such as Locke and Hume, describe innate ideas about objects as superfluous (Baillargeon and Carey, 2012; Spelke and Kinzler, 2007). Empiricists believe that the human mind is a "flexible and adaptable mechanism for discovering regularities in experience" based on a "single learning system that copes with all the diversity of life," including objects (Spelke and Kinzler, 2007, p. 89). In this sense, empiricists assume that humans make sense of objects by detecting their sensible properties through experience (Spelke, 1988). Empiricist ideas about human-object interaction have guided much of the 20th Century thinking about human behavior, influencing psychologists such as Watson (1924), Skinner (1938), and Piaget (1954), who, in turn, have informed notable psychologists such as Gibson (1979) and Hinton (1993), and, in turn, allied reference disciplines such as information systems (IS).

In 1965, Noam Chomsky challenged the empiricist ideas by reintroducing a more rationalist viewpoint based on evolution. In the context of language, Chomsky (1965) argued that infants are born with "universal grammar that makes possible their rapid acquisition of language" (Baillargeon and Carey, 2012, p. 2). In doing so, Chomsky contended that innate ideas are rooted in unconscious psychological and biological systems brought about by evolutionary adaptation, and that the psychological mechanisms involved in human cognition are no exception. These ideas eventually led to the field of evolutionary psychology (Cosmides and Tooby, 1994), which claims that the human mind is "a collection of special-purpose mechanisms, each shaped by evolution to perform a particular function" (Spelke and Kinzler, 2007, p. 89).

In 1988, Elizabeth Spelke (1988) adopted the concept of innate ideas to study how infants perceive objects. She reasoned, like other developmental psychologists, that if humans had innate ideas, they could be found in infants. Indeed, Spelke (1988) discovered that infants have a set of innate principles that guide object cognition. In other words, infants, as well as human adults, conceive of objects through a set of innate principles (Spelke, 1988).

In 2000, based on over a decade of research, Spelke introduced the theory of core knowledge (Spelke, 2000). Core knowledge theory is the idea that, in the human mind, there are core principles embedded in core knowledge systems that "build representations of objects, persons, places, and numerosities that encompass quite abstract properties and relationships, such as the persistence of objects over occlusion and

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the goals of perceivable acts" (Spelke, 2000, p. 1233). These core knowledge systems are separate but interrelated knowledge systems on which new, flexible skills and belief systems develop (Spelke and Kinzler, 2007). One of the most extensively studied core knowledge systems is the system of object representation (Spelke and Kinzler, 2007; Spelke, 2000). Within this system there exist three principles that govern how humans conceive of objects and use objects to interact with and manipulate the world: cohesion, continuity, and contact (Bloom, 2005; Spelke and Kinzler, 2007). Additionally, innate principles in a core knowledge system called the agent system govern how humans anticipate perceivable, goal-oriented actions. These principles include goal-directedness, efficiency, reciprocity, and potential effects.

In the context of IS research, debates about what technology is (i.e., the information technology (IT) artifact), including ideas about how the IT artifact is (and should be) perceived and conceptualized, have also been ongoing for several decades. For example, DeSanctis and Pool (1994) argued that IT artifacts should be conceptualized in terms of their structural features and spirit; they emphasized that IT artifacts, at their core, involve designers' intentions and users' perceptions. Orlikowski and Iacono (2001) identified five views of IT artifact conceptualization, which offer IS researchers specific ways to view and theorize the IT artifact. In 2003, Benbasat and Zmud (2003) argued for a new conceptualization of the IT artifact in terms of its "structures, routines, norms, and values implicit in the rich contexts within which the artifact is embedded" (Benbasat and Zmud, 2003, p. 186). Since then, the IS discipline has embraced a more "material" approach to theorizing the IT artifact, and has adopted the terms digital object and digital agent to conceive of its material and nonmaterial nature (Faulkner and Runde, 2019; Recker, et al., 2021).

While IS research on how to theorize and conceptualize technology has laid a solid foundation for the IS discipline, and has helped to guide countless investigations on sociotechnical phenomena, most, if not all, of the theorizing has overlooked the role of the innate principles and specifically how innate principles play a role in shaping how a user conceives of the digital object and perceives the goals of the object-directed actions involving the digital object and its features.

The goal of this paper is to add to the body of knowledge about how to conceptualize the IT artifact as a digital object through the innate principles embedded in two systems of core knowledge: the object representation system and the agent system. We theorize that the interaction between the user and the digital object (Faulkner and Runde, 2019; Recker, et al., 2021) is foundationally built on three interconnected innate principles of object representation (cohesion, continuity, and contact) (Spelke and Kinzler, 2007) as well as four interconnected innate principles of the agent system (goal-directedness, efficiency, reciprocity, and potential effects) (Spelke and Kinzler, 2007).

The concepts of core knowledge and innate principles are instantiated in the context of IS research through a framework we call the *user-object action scene* (Robson and Kuhlmeier, 2016). The action scene is a fictitious scene involving elements related to a user carrying out a goal-directed action through a digital object. We use the framework to describe the role of four key elements involved in the action scene and how they relate to innate principles: (1) the user enacting the object-directed action, (2) the goal-object and goal-agent, (3) the object-approach, and (4) the goal environment in which the object-directed action occurs (Robson and Kuhlmeier, 2016).

Overall, the paper makes several contributions to IS research. First, by adopting concepts embedded in core knowledge theory, we reconceptualize the relationship between the user and the digital object as one guided by innate principles. Second, we take a first step to illustrate how innate principles guide the key elements involved in a user interacting with a digital object. Third, we reinterpret how goal-directed action through objects is shaped by innate principles, which provides IS researchers with a more evolution-based foundation of goal-oriented action and artifact actualization (Strong et al., 2014). Fourth, we provide encouragement and guidance about how IS researchers can use innate principles to investigate IS phenomena, and specifically discuss how to use the principles of the object representation system to examine the role of innate principles in two widely cited IS research streams: technology acceptance and technostress. Overall, we hope that by viewing the user-object interaction through the lens of innate principles, IS researchers can begin to reevaluate sociotechnical phenomena surrounding the design, capabilities, practices, impact, and use of technology, through innate ideas.

2. Digital objects & digital agents

Digital objects in IS research are often described as material and nonmaterial. Material objects have been defined in terms of a physical mode of being and nonmaterial objects in terms of a nonphysical mode (Faulkner and Runde, 2019). Digital objects have also been discussed as being hybrid objects, which are digital objects that have material and nonmaterial features, and as having a syntactic quality, meaning that they are inscribed with "symbols arranged into well-formed expressions, where well-formed means that these expressions adhere to the syntactical and semantic rules of the language in which they are couched" (Faulkner and Runde, 2019, p. 1284).

A more unified view of digital objects in IS research is given by Leonardi (2010), who argues that IS researchers should consider discussing the material and nonmaterial features of digital objects through one concept: *materiality* (Leonardi, 2010). Materiality, as defined by Leonardi (2010), can be thought of in several ways. One way is to consider digital objects as having both material and nonmaterial features that are significant and relational, or as "things that are pertinent to the task at hand" (Leonardi, 2010). Under this unified material view, the user conceives of the digital object as a whole and takes action through the material and nonmaterial features embedded in the digital object as related to a goal-directed action. The relevance of the features depends on the context and circumstances shaping the user-object interaction (Leonardi, 2010).

In this paper, when we refer to the material features of the digital object, we take the view of materiality offered by Leonardi (2010). That is, we discuss the material *and* nonmaterial features using one term: features. We consider the features as embedded in a digital object and consider the relevancy of the features determined by the user and shaped by a goal-directed action.

Recently, digital objects have been described as digital agents. For example, in a recent *MIS Quarterly* theory article, Recker et al. (2021) argue that "digital objects increasingly have material agency, that is, the capacity to act on their own, without human intervention" (p. 275). In this sense, a feature of a digital object can be perceived by the user as an agent for action (Recker et al., 2021). The authors claim that the action through digital agents can occur by humans and/or by the digital agent itself.

Much of the IS research on the concept of digital objects as related to action involves the construct of affordances, which are framed as potential actions offered by the digital object (Fayard and Weeks, 2014; Markus and Silver, 2008' Cheikh-Ammar, 2018; Leonardi 2011; Zammuto et al., 2007). More directly, affordances have been defined as "the possibilities for goal-directed action provided by an object in relation to a goal-oriented actor" (Strong et al., 2014, p. 54). In use, affordances are typically employed by IS researchers to identify the features of a digital object related to action (Cheikh-Ammar, 2018). For example, Strong et al. (2014) found several relevant affordances related to healthcare workers using an electronic healthcare record (EHR) system. One affordance identified by the authors was "capturing and archiving digital data about patients," which is associated with the EHR system's feature of a structured data entry form (Strong et al., 2014, p. 54).

Overall, IS research on digital objects, materiality, features, digital agents, and action has enabled IS researchers to develop valuable insights regarding sociotechnical phenomena (Sarker et al., 2019). However, many of the current theories surrounding digital objects, digital agents, materiality, and action are not based on innate principles that shape how the user makes sense of the digital object and its features, and that influence how the user perceives the goals of the digital object and its features as related to object-directed action.

Below, we discuss how innate principles related to object cognition and the agent system can offer IS researchers a more intrinsic view of how the user acts through the digital object to carry out a goal-directed action.

3. Core knowledge theory

As discussed in the introduction, core knowledge theory is an approach to developmental psychology based on the idea that "humans are endowed with a small number of separable systems of core knowledge" and that "new, flexible skills and belief system build on these core foundations" (Spelke and Kinzler, 2007, p. 89). Spelke and colleagues have gathered substantial evidence indicating that four core knowledge systems are innate in both human infants and adults (and nonhuman animals), and that these knowledge systems shape how individuals interact with the world (Kinzler and Spelke, 2007). The four core knowledge systems are: (1) core knowledge of objects, (2) core knowledge of agents, (3) core knowledge of spatial relationships, and (4) core knowledge of numerosity (Kinzler and Spelke, 2007; Spelke and Kinzler, 2007). Below, we focus on two of the core knowledge systems associated with object representation and perceivable action through agents; we consequently provide a framework for how IS researchers can use the concepts embedded in core knowledge theory.

3.1. Core knowledge of objects: Cohesion, continuity, and contact

The *core knowledge system of objects*, which is referred to as the core system of object representation or object cognition, is the most widely studied of all the four knowledge systems (Kinzler and Spelke, 2007). Initially, Spelke (1988), through a series of task experiments on infants, determined that infants have innate principles guiding their interpretation of objects and events involving objects. In infants, these core principles make up an initial concept of an object; in adults, these principles constitute the core of an object concept (Spelke, 1988). The three core principles of object representation are the principles of cohesion, continuity, and contact.

The *principle of object cohesion* is the principle that objects have specific boundaries and stay consistent over time (Spelke and Kinzler, 2007). That is, objects "are connected masses of stuff" that move as a whole and cannot fuse with other objects (Bloom, 2005). Moreover, objects cannot suddenly disintegrate as they move (Baillargeon and Carey, 2012). In essence, this principle ensures that humans can perceive an object's boundaries (Kinzler and Spelke, 2007; Spelke and Kinzler, 2007). *The principle of object continuity* is the principle that objects exist and function continuously in time and space. Under this principle, objects move on continuous paths and cannot spontaneously appear or disappear (Spelke, 1988). This principle ensures that humans can identify objects as a complete shape as they move in and out of view. *The principle of object contact* is the principle that objects move through contact (Bloom, 2005). In other words, an object does not move unless something interacts with it. This principle ensures that humans can "predict where objects will move and where they will come to rest" (Kinzler and Spelke, 2007, p. 258).

The principles of object representation provide an alternative but complementary viewpoint regarding the psychology of perception, on which much of IS research is based (e.g., Gibson, 1979). For example, many researchers argue that humans perceive and learn about objects through their sensory properties, such as color or weight (Spelke and Kinzler, 2007). While this may be true, there is a deeper layer involved in object sense-making through the innate principles of cohesion, continuity, and contact. For example, humans indeed make sense of objects and their functions through properties and repeated action or use; however, such properties are governed by the core foundations of object representation (Kinzler and Spelke, 2007; Spelke and Kinzler, 2007). This is not only true in human infants, but adults as well. Research on human adults, for instance, finds that adults recognize objects through sensory properties and features of objects. This sensory information helps adults to distinguish among a variety of object types, such as tools and food (Spelke and Kinzler, 2007). However, when attention is spread thin, as it is in many workplace environments, adults tend to conceive of objects through cohesion, continuity, and contact rather than the object's properties or features (Leslie et al., 1998).

It should be noted that in her classic work, Spelke (1988) argues that psychological frameworks which assume humans make sense of objects through object properties and features, such as the work by Gibson (1979), do not address the entire picture. Instead, Spelke (1988) states:

> *"All [previous frameworks on object perception] assume that objects are perceived: that humans come to know about an object's unity, boundaries, and persistence in ways like those by which we come to know about its brightness, color, or distance. I suggest, in contrast, that objects are conceived: Humans come to know about an object's unity, boundaries, and persistence in ways like those by which we come to know about its material competition or market value … the ability to apprehend physical objects appears to be inextricably tied to the ability to reason about the world"* (p. 198, brackets added for clarity).

3.2. Core knowledge of agents and object-directed action

In addition to governing how humans make sense of objects, the principles embedded in the core system of object representation relate to how humans accomplish goal-directed action through objects (Scholl et al., 2001). Goal-directed action is central to another core knowledge system: *the agent system* (Spelke and Kinzler, 2007). Like the object system, much of the research on the agent system began in the context of infants observing other individuals, called agents, perform goal-directed actions. These studies revealed that infants possess four innate characteristics to make sense of the perceivable acts of the agent: goal-directedness, efficiency, reciprocal interaction, and action effects (Robson and Kuhlmeier, 2016). Research on human adults also finds that adults, like infants, anticipate perceivable actions from agents in terms of their goal-directedness, efficiency, reciprocity, and potential effects (Spelke and Kinzler, 2007).

When perceived as *goal-directed*, an observer expects an agent to carry out a goal related to the action; when perceived as *efficient*, an observer expects an agent to achieve a goal as efficiently as possible within the confines of the environment; when perceived as *reciprocal*, an observer expects an agent's actions to match the observer's own goal representations, a phenomenon associated with mirror actions and the direct matching hypothesis; and when perceived in terms of potential *action effects*, an observer binds together the action of the observer to expected effects of that action (Robson and Kuhlmeier, 2016).

Object-directed action differs slightly from goal-directed actions. That is, object-directed actions are governed by goal-directedness, efficiency, reciprocity, and action effects (Robson and Kuhlmeier, 2016); however, actions through objects involve a process of sense-making based on the expectation or prediction of objects through cohesion, continuity, and contact. This process is referred to as *object-directed goal attribution*, which is a goal-directed process by which humans form either an expectation or a prediction about the target or future action through an object (Robson and Kuhlmeier, 2016). It is therefore difficult to achieve an object-direction action without understanding what an object is, which is the core function of the object representation system (Spelke and Kinzler, 2007). For example, a user must first conceive of the digital object and its features through the principles of object representation to anticipate the perceivable actions of the action-oriented features.

Above we have explained how humans make sense of objects and how humans anticipate actions as governed by innate principles involved in two core knowledge systems: core knowledge of objects and core knowledge of agents. Below, we apply these concepts to IS research through a framework we call the user-object action scene.

4. The user-object action scene

In the following section, we argue that the innate principles central to the object system and agent system are applicable to IS phenomena. We position the innate principles of the object representation and agent system as core mechanisms that shape how the user conceptualizes the digital object in terms of object-directed actions through digital objects and their features. We consider the principles of object representation as core principles that govern digital object cognition; that is, the principles of the object system govern how the user conceives of what the digital object is.

We first redefine the three innate principles of digital object cognition in the context of IS research. *Digital object cohesion* is the principle that the digital object and its associated features have specific boundaries and stay consistent over time. They cannot spontaneously fragment as they move or fuse with other digital objects (Baillargeon and Carey, 2012; Spelke and Kinzler, 2007). *Digital object continuity* is the principle that the digital object and its associated features exist and function continuously. The digital object and the embedded features cannot spontaneously appear or disappear (Baillargeon and Carey, 2012; Spelke and Kinzler, 2007). *Digital object contact* is the principle that the digital object and its features have a specific role and purpose, and that the digital object and features function through contact. That is, the features are not going to function unless something contacts them (Baillargeon and Carey, 2012; Spelke and Kinzler, 2007).

The principles of the agent system, we argue, represent core principles that govern how the user perceives the goals of the features embedded in the digital object. We consider the features of the digital object to be digital agents, meaning that, when interacting with and using the features of the digital object, the user, through the agent system, anticipates the goals of the perceivable features to act in terms of goal-directedness, efficiency, reciprocity, and action effects.

We elaborate on these definitions below through the elements of a framework we call the *user-object action scene* (see Figure 1). The user-object action scene is a fictitious action scene comprised of four key elements involved in a user performing a goal-directed action through a digital object: the user, the goal-object/goal-agent, the object-approach, and the goal environment. Each element is related through a process of user sense-making. A summary of the four elements can be found below and in Table 1.

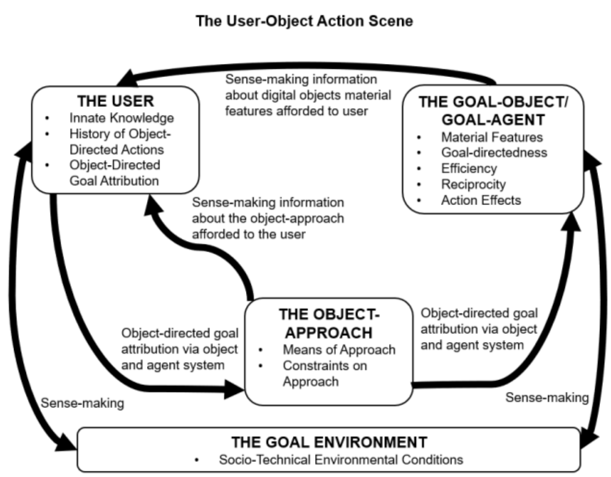

Figure 1. The user-object action scene.

4.1. The User

The user represents the individual who interacts with the features of the digital object. The user enters the action scene endowed with the principles of the object system and agent system embedded in their cognition. The user also enters the action scene with a personal history and experience with object-directed actions, a history that shapes how the user makes sense of the digital object and its embedded features and goal-agents. For example, the user may have been habituated to similar features of a similar digital object or the digital object-in-use (e.g., typing skills, knowledge about the software interface). The user may also have experienced previous object-directed action in a different setting (Robson and Kuhlmeier, 2016).

Endowed with this information, the user encounters a situation that urges or requires action through a digital object and its features. Through object-directed goal attribution, the user therefore expects or predicts how the action will be appropriated through the digital object. How the user makes sense of the goal-object and its associated features, and how the user makes sense of how to act on the goal-object through its associated features, is governed by the principles of digital object cohesion, continuity, and contact.

For example, when intending to act on a feature of the digital object, such as a clicking a submit button on a screen, the user may carry out this action by using their finger to left click a physical button embedded in a computer mouse. Through the principles of object representation, the user, therefore, expects the submit button on the screen and the mouse button to be cohesive, have continuity, and function through contact.

Through *cohesion*, for example, the user expects the mouse button and the submit button to be separate features, thereby perceiving the boundaries of both. The user also expects the submit button to be a separate entity from the other features on the screen and expects the left-click mouse button to be separate from and have different boundaries than the right-click mouse button. In this way, the user expects the features not to fuse with other features on the screen. Through *continuity*, the user expects the mouse button and the submit button to persist and function as it has functioned in the past. In this sense, the user predicts that the actions that have occurred in the past through these specific or similar features will endure. Last, through *contact*, the user expects that, when clicking on the mouse button and the submit button, information will indeed be submitted, and there will not be an interruption in the process.

4.2. The goal-object/the goal-agent

The *goal-object* represents the contextually relevant digital object and embedded features that will be appropriated to achieve goal-directed action (Leonardi, 2010). We argue that, as discussed above, for simplicity, the goal-object and its features should be thought of as *relevant features*, or simply *features* (Leonardi, 2010). That is, the goal-object is comprised of features, which represent features (a computer mouse and/or a submit button). These features are pertinent to the user's task given the overarching environmental conditions related to the object-directed action. In this sense, the goal-object may be conceptualized as a whole (e.g., an EHR system), while the features represent more specific properties of the goal-object. Moreover, there are some features that are more contextually significant than others as guided by the goal-directed action (Leonardi, 2010).

The goal-object and its features should also be considered digital agents for action, or *goal-agents* (Recker et al., 2021). That is, we argue that since the user performs an action through the of the goal-object, the user perceives the features as an agent for action driven by the user's intended goals (Recker et al., 2021). In this sense, the user perceives the goal-object and its associated features to be agents for action, which activates the agent system of core knowledge. The goal-object and its features are therefore subject to the core principles of the agent system: goal-directedness, efficiency, reciprocal interaction, and action effects.

For example, if a user wants to purchase an item for a website (a goal-object), the user must enter their payment information into a digital form comprised of radio buttons, drop-down menus, and textboxes. The user must also click a submit button to submit the payment information. We will use the submit button to represent a material feature (a goal-agent) to purchase the item. In this sense, the submit button as a goal-agent is a material feature of the goal-object that should align with the user's contextually relevant goal of submitting payment information. The submit button should therefore be *goal-directed* and *reciprocal* by conveying to the user information about how the user can use the button to achieve the object-directed goal to purchase an item online. The submit button should also be considered an *efficient* way to submit payment for the item. For example, its location should be obvious and easy to find, and the user should be able to click the submit button without hesitation. Last, the submit button is subject to the user's preconceived notion about potential *action effects* associated with the submit button. For example, when clicking submit, the user may anticipate an immediate response from the website by immediately taking the user to a receipt page.

4.3. The object-approach

A key part of the user-object action scene, and one that is often not discussed in IS research, is the object-approach. The object-approach represents the manner through which the user completes the action. To act upon a digital object, for example, the user must bring themselves into contact with the goal-object and the relevant features in a way that affords the particular action. The object-approach should also align with how the user perceives the digital object through the principles of cohesion, continuity, and contact.

The object-approach involves two parts: the means of the approach and the constraints on the approach. The means and constraints on the approach involve the manner through which the user acts on the goal-object (the means) and the ways in which the approach is hindered (the constraints). For example, the user can interact with the goal-object through a variety of interfaces: through a keyboard, a mouse, a touchscreen, a voice command, gestures, head movements, and/or gazes, depending on the goal-object. The *means of the approach*, then, represents the patterns surrounding how the user engages with the goal-object, and how the goal-object responds to the approach. A successful user-artifact interaction involves an object-approach that aligns with cohesion, continuity, and contact. If the user approaches the object through a voice command, for instance, the goal-object should respond in a manner that aligns with the three core principles of object representation and the agent system. If the goal-object does not respond in this way, then there are *constraints on the approach* and therefore constraints on the goal-directed action. The means and constraints shape the user's history of object-directed actions.

4.4. The goal environment

The goal environment involves the socio-technical conditions of the environment in which the action occurs. The environment in which an action occurs, especially a workplace, is often governed by three core factors: plurality, change, and scarcity (Smith and Lewis, 2011). Plurality is associated with uncertainty and competing goals and organizational processes. Change involves altering states of short-term and long-term needs and desires. Scarcity entails limitations on time, human, financial, or other resources, (Smith and Lewis 2011). Often these core elements of the environment materialize into organizational mechanisms such as role demands, task demands, interpersonal expectations, social norms, and workplace policies (Califf et al., 2020).

The user, object-approach, and goal-object also impact the goal environment. For example, change is often a recurring mechanism in IS research. Digital objects and their features are constantly changing (Tarafdar et al., 2007). This change likely interferes with the principles of cohesion, continuity, and contact. For instance, if the user expects a material feature to remain continuous, and it changes, the user must undergo a new sense-making process to learn how to use it. The user, however, may welcome the change, if they are able to perceive the change as valuable to their contextually relevant goals.

4.5. User sense-making

In Figure 1, the four previous discussed elements involved in the user-object action scene are interconnected through relationships guided by user sense-making (Griffith, 1999). User sense-making has been defined as a process "initiated through interactions with IT features in which action potentials are deduced, an interpretative process often facilitated by the rich symbolism that is embedded in features" (Cheikh-Ammar, 2018, p. 288). In our case, we focus on the interpretive sense-making processes as governed by the core principles in the object representation system and the agent system.

The following discussion illustrates the user-sense making process in the user-object action scene. When a user interacts with an object, they do so in an environment that urges the user to carry out a goal through a digital object (the goal-object). The goal environment therefore affords information to the user about the goal, and how to appropriately achieve the goal as related to other socio-technical environmental factors. The goal-object also affords the user rich sensory and syntactic information about what the object is and how it functions. This information afforded by the goal-object represents the "rich symbolism" embedded in the object's features (Cheikh-Ammar, 2018).

To make sense of what the goal-object is, the user processes and encodes the rich information afforded by the goal-object, coupled with information about the overarching goal, through the principles of cohesion, continuity, and contact. To make sense of how the goal-object functions as related to the object-directed action, the user processes and encodes the information afforded by the goal-object and its features in terms of goal-directedness, efficiency, reciprocity, and effects. Through this sense-making process, the user identifies the relevant features of the goal-object as related to their object-directed goal and determines the appropriate means to approach the goal-object. If there are no constraints on the approach, the user ultimately uses the goal-object and its material features to actualize a goal-directed action.

Table 1. The Four Elements Involved in the User-Artifact Action Scene		
Component	**Description**	**Key Concepts of the Component**
The User	The individual who interacts with the features of the digital object. The user enters the action scene equipped with the innate knowledge of the object system and agent system embedded in their cognition.	• *Innate Knowledge*: The three principles of object representation: cohesion, continuity, and contact. • *History of Object-Directed Actions*: The user's history and experience with object-directed actions (e.g., knowledge of goal-objects and functions) • *Object-Directed Goal Attribution*: an expectation or a prediction regarding the goal-object/goal-agent's ongoing or future action.
The Goal-Object/ The Goal-Agent	The relevant digital objects that will be appropriated to achieve goal-directed action through relevant features. The goal-object and its features should be considered agents for action, or goal-agents. The digital object and its embedded features are, therefore, subject to the core principles of the agent system.	• *Relevant Features*: Digital objects have relevant material and nonmaterial properties that we consider relevant features. • *Goal Directedness*: A material feature/goal-agent achieving a goal related to the user's object-directed action. • *Efficiency:* achieving an object-directed action efficiently as conditioned by the environmental constraints. • *Reciprocity*: The user is directly matching the goals of the digital object/goal-agent to their own goal representations. • *Action Effects*: The binding together of an action and the perceived effect of that action through the digital object/goal-agent.
The Object-Approach	The manner through which the user completes the action. The user must bring themselves into contact with that object and associated feature in a way that affords the particular action.	• *Means of Approach*: The patterns surrounding how the user engages with the goal-object, and how the goal-object responds to the approach. • *Constraints on the Approach*: The ways the means of the approach is hindered. • For example, if the user approaches the object through a voice command, the goal-object should respond in a manner that aligns with the three core principles. If the goal-object does not respond in this way, then the approach could be considered constrained.
The Goal Environment	The socio-technical conditions of the environment in which the action occurs. The environment in which an action occurs is often governed by three core factors: plurality, change, and scarcity.	• *Potential Environmental Factors:* plurality, scarcity, change, role demands, task demands, interpersonal expectations, social norms, and workplace policies.

7. Revising theories through core knowledge and evolutionary misfit

We encourage IS researchers to revisit IS theories through core knowledge, and, specifically, through the principles of object representation. We expressly advocate that, if doing so, IS researchers may consider the concept of *evolutionary misfit* (Cosmides and Tooby, 1994; Hamilton, 2008). Evolutionary misfit is used by evolutionary psychologists to argue that modern-day humans have evolved innate Paleolithic cognitive mechanisms that are not well well-suited for life in the modern world (Hamilton, 2008). In essence, the innate cognitive mechanisms can be maladaptive, meaning that they represent a "misfit" in activities central to today's modern environment, like technology use.

IS researchers may consider the principles of object representation—cohesion, continuity, and contact—as innate cognitive mechanisms that have evolved alongside humans. Coupled with the notion of evolutionary misfit, we argue that cohesion, continuity, and contact may play an important role in how the modern-day technology user perceives and uses the digital object. For example, the modern-day technology user may conceptualize an object by having a *fit* among cohesion, continuity, and contact, meaning that, for the digital object to be useable, it must have a high degree of cohesion, continuity, and contact. A *misfit* in cohesion, continuity, and/or contact, may, therefore, result in the user *not* using or *not* accepting the technology, and potentially experiencing technology-related distress associated with using the technology. We elaborate below on these ideas below.

7.1. Core knowledge and IT Acceptance

Information technology acceptance has dominated the IS discipline since the late 1980s (Davis, 1989; Venkatesh et al., 2003). The core constructs in the technology acceptance model, or TAM, are perceived usefulness and perceived ease of use. Perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320). Perceived ease of use is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320). When there is a high degree of perceived usefulness and perceived ease of use the user will generally accept and use the technology.

We encourage IS researchers to revisit perceived usefulness and ease of use as guided by a "fit" or a "misfit" among the innate principles of cohesion, continuity, and contact. For example, cohesion, continuity, and contact, as argued above, represent the core of an object concept. If a user perceives the object as having a low degree of cohesion, continuity, and/or contact, the user experiences a "misfit" in their object representation, and the user's object concept is thwarted. Because the object concept is hindered, the user likely experiences a low degree of usefulness and ease of use, and, in turn, is likely reluctant to accept and use the technology in question.

7.2. Core knowledge and technostress

Technostress is relatively recent theory in the IS discipline but has received a great deal of attention (Califf et al., 2020; Ragu-Nathan et al., 2008; Tarafdar et al., 2007). Technostress is an overarching process comprised of technology-related challenge technostressors and hindrance technostressors. Challenge technostressors are stressors that individuals tend to appraise as related to promoting task accomplishment, while hindrance stressors are technostressors that individuals tend to appraise as related to a barrier or obstacle to task accomplishment (Califf et al., 2020).

We encourage IS researchers to revisit the technostress literature through core knowledge. Specifically, IS researchers could study the relationship between cohesion, continuity, and contact and challenge/hindrance techno-stressors. For example, a core hindrance technostressor is unreliability, which is defined as "problems associated with the dependability and consistency of technology" Califf et al., 2020, p. 813). This can be understood as a violation of the principle of digital object continuity, which involves the digital object and its features not spontaneously appearing or disappearing. A modern technology user has likely experienced technology suddenly shutting down, or suddenly restarting, thereby hindering task accomplishment. In this sense, the user may consider the technology as lacking continuity, which contributes to a misfit in object conception, and ultimately hindering task accomplishment.

8. Conclusion

This paper adds to the body of knowledge theorizing the key mechanisms involved in the relationship between the user and the digital artifact; it proposes that innate knowledge is key to understanding how individuals interact with digital objects. Through core knowledge theory, we discuss how IS researchers can adopt innate principles to reexamine and reinterpret the relationship between the user and the IT artifact. We hope this paper helps to spotlight the importance of innate principles in IS research and encourages IS researchers to reexamine sociotechnical phenomena through the lens of innate ideas.

9. References

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