

Developing an Integrative Semiotic Framework for Information Systems: The Social, Personal and Material Worlds

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Abstract The paper argues that semiotics, the theory of signs and symbols, is at the heart of the representation and transmission of information and meaning, and is thus central, to communication and information systems, but especially in their contemporary, more virtualized forms. The paper is distinctive in eschewing post-structuralist uses of Saussurian semiotics, and recent theorizations of sociomateriality, instead developing an integrative framework grounded in Habermasian concepts, Peircean semiotics and an underlying, integrating critical realist philosophy. We develop a semiotic framework to help analyze the complex interactions between three different worlds – the personal, the social and the material. Here semiosis relates to the personal world through the generation and interpretation of signs and messages. It relates to the material world in that all signs must have some form of physical embodiment in order to be signs, and must also be transmitted through some form of physical media. Semiosis relates to the social world in that the connotive aspects of sign systems are social rather than individual – they exist before and beyond the individual's use of signs. The personal, social and material worlds between them bear relationships of sociation, sociomateriality and embodiment. The framework draws on fundamental concepts of information, meaning and embodied cognition. The paper examines critically the implications of this formulation for studying information systems. It discusses commonalities with and departures from other studies, illustrates points with empirical examples, and details how the integrative framework can be utilized.

Keywords: critical theory, critical realism, embodiment, information, meaning, semiosis, semiotics, philosophical foundations.

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1. Introduction

The two most distinctive characteristics that distinguish human beings from other animals are their advanced ability to use language to co-ordinate their actions (Goldkuhl & Lyytinen, 1982; Hirschheim, Klein, & Lyytinen, 1996; K. Lyytinen, 1985; Maturana, 1978; Mead, 1934) and the ability to develop and use tools to shape their environment (Habermas, 1978). Language and communication are based fundamentally on meaning and signification which is essentially cognitive, while tools and technology are primarily realized in a physical form. Information systems, or more generally information and communication technology (ICT), cut across this divide in that they concern language and signification embodied and transmitted through technology. This is nothing new but undoubtedly, with mobile technologies and social networking, it is more so than ever before.

We can see, therefore, that ICT inevitably involves an inter-twining of two worlds – the social and the technical – and this relationship has been extensively debated. We can distinguish three primary positions regarding this relationship. First, are those who emphasize the dominance of one system over the other. Within this category are the technological “determinists” such as Woodward (1958) and Perrow (1970) who argue that the nature of the technology imposes major constraints on individuals and organizations. More recent work is highly varied in scope and level but generally treats technology as an independent variable within the research (W. Orlikowski & Scott, 2008, p. 439-446). Perhaps in reaction to this view, there developed a focus on the social aspects of technology – the ways in which people organized around or shaped technology (Howcroft, Mitev, & Wilson, 2004) – which includes the social shaping of technology (SST) and the social construction of technology (SCOT) (Pinch & Bijker, 1984) perspectives. These could be seen as social “determinists”.

Second, there are those who conceptualize two ontologically distinct systems that interact and mutually influence each other (W. Orlikowski & Scott, 2008, p. 446-454). Examples are the original socio-technical studies of Trist and colleagues (Trist & Murray, 1993), Zuboff’s (1988) study of the process of informing, and Zammuto et al’s (2007) work drawing on Gibson’s theory of ecological perception and affordances. Third, and most recent, we find theorists who argue that the two systems are so inextricably inter-twined that they cannot in fact be separated, for example, actor-network theory (ANT) (Callon, 1991; Latour, 1987),

object-centered sociality (Knorr-Cetina, 1997), agential realism (Barad, 2003) and relational materiality (Law, 2004). Within IS, this position has been called “sociomateriality” to emphasize the inseparability of the social and the material (Leonardi & Barley, 2008; W. Orlikowski, 2000, 2007; W. Orlikowski & Scott, 2008) and is, in part, the subject of this paper.

Sociomateriality, taken in a strong form, has profound implications for it argues that the social and the material are so deeply inter-related and mutually constituting that it is not in fact possible, even analytically, to separate them. We follow Mutch (2013) in arguing against that position and instead maintain the critical realist view that they are actually two, ontologically independent but interacting structures. Mutch’s paper concerns the work of Barad (2003), who is a philosopher of natural science, whose work has been drawn on Orlikowski et al. as an underpinning for sociomateriality. Barad is mainly considering quantum physics but generalizes her ideas to encompass social systems as well. Barad’s primary contention is that we cannot consider that there is some independent object world (for her at a quantum level) and then separately an observer who conceptualizes it. Rather, she maintains what she calls agential realism. She argues that there are real phenomena but that they only come about in the entangled interaction of a multiplicity of elements, including the observer and their observing apparatuses, and that this happens in such a way that it is impossible to separate out the two. Any partial resolution of this indeterminacy is brought about by what she calls an “agential cut” which “enacts a local resolution within the phenomenon of the inherent ontological indeterminacy” (Barad, 2003, p 815).

Mutch raises a number of criticisms of Barad’s work, and hence of sociomateriality more generally. In brief: i) that her interpretation of quantum theory is itself contentious (Norris, 2000) and her generalization of this to non-physical realms such as the social world even more so; ii) that the focus on the actuality of practice loses the temporal dimension of analysis, ignoring the fact that social structures already pre-exist those acting at a particular point in time; iii) that empirical studies have found it difficult to actually operationalize this approach, particularly (and ironically) finding it hard to conceptualize the material aspects of the sociomaterial; iv) Barad’s approach tends to reduce empirical analysis to the descriptive

accounts of participants and so does not recognize the unacknowledged conditions of action, and unintended consequences of a world that is not necessarily transparent to social actors.

Leonardi (2013), in a generally sympathetic response to Mutch, argues that there should not be an either/or between critical realism and agential realism as underpinning philosophies for sociomateriality but that they rather should be seen as alternatives that could be used in different contexts. However, this assumes that sociomateriality is somehow separable from its philosophical underpinnings and justifiable in its own right, and that it is compatible with the presuppositions of critical realism, contentions which we do not accept. We observe additional limitations of recent representations of sociomateriality. First, that ICT also involves a third world, as well as the social and material, which is the individual or personal (Habermas, 1984, 1987). Ultimately, communications and information systems rest on individuals who create and send, or have sent, messages and data; then receive and interpret them; then act (or not act) upon them. Habermas (1990), in developing his theory of communicative action and discourse ethics (Mingers & Walsham, 2010), emphasized the ontological and epistemological *differences* between three worlds all of which are necessary to understand the nature of human communication. Second, there is the fundamental problem of representation. Information systems do not simply store and transmit pure information, but rather *representations* of that information, and the form of the representation itself significantly affects the meaning that the information may generate – what we can call the *semiotics* of information. The performative effects of representation in itself has been explored by Cooper (1992, 1993), Lilley et al (2004), Dulipovici and Robey (2013), and Kallinikos (1993), and we explore these dimensions in this paper.

The paper begins by signaling the need to develop a richer way of using semiotics in the study of information systems. In the next five sections we build, out of a fundamentally Peircean semiotics, our theoretical integrative framework. We begin with philosophical underpinnings drawn from Habermas and critical realism as these are broad enough to encompass a variety of different domains – material, social and personal - and also have links to both Peirce's work generally and semiotics in particular. We then move to a detailed discussion of Peircean semiotics as the key to our framework. There follows a semiotic analysis of the nature of information (surely key to *information* systems) and its relationship

to meaning. From this we consider the manner in which people both produce and interpret communications as a process of embodied cognition. Our development process results in an integrative framework that locates semiosis as the founding set of operations at the centre of three worlds – the personal, social and material. In the final sections we illustrate use of the integrative framework in information systems studies with two empirical examples and conclude by returning to the discussion of sociomateriality.

2. From Sociomateriality to Semiotics

Orlikowski (2010) provides a powerful example of the issues this paper deals with, and the relevance of the integrative framework we will develop. She describes MPK20, and the Sun Microsystems Project Wonderland rooms, offices, screens and documents that form part of an online, three dimensional, immersive environment for workplace collaboration. While she does not develop the analysis of this synthetic world, she asks interesting questions of how they can be researched. She chooses the perspective of entanglement and draws upon actor network theory and Barad's (2003) notion of "apparatus" to focus the research possibilities. However, given the centrality of humans and of meaning and communication in how MPK20 and the Project Wonderland Rooms operate, the sociomateriality perspective as described lacks a coherent semiotic dimension in understanding the material, social and personal worlds being described and analyzed. How does meaning arise? What sign systems are operating and how are they employed? What are the power dimensions of the control or lack of influence over meaning, communication, and information? How do social structures and processes relate to personal understandings and influence action? What is the role of non-material technological objects in the generation of meaning, behavior and performance? These are only illustrative additional research questions that follow from using the integrative summary framework we will develop, but do not flow easily from applying a more limited 'sociomateriality' perspective.

Our foregoing arguments suggest that communication and technology needs to be more precisely located within a broader integrative framework that makes more explicit a family of concepts and their relationships needed to study advanced information and communications technologies in contemporary organizations. In order to accomplish this, we have found it necessary to move to a level of theory beneath these three worlds – the social, personal and

material - from which we can address their inter-connections. Communication is underpinned by systems of meaning and signification, and the discipline that most thoroughly deals with signification in general is *semiotics* or *semiology* – the science of signs and sign production and transmission. A sign is an event, an object, a symbol or a behavior that *represents* something other than itself. Signs depend upon a shared set of meanings within a particular community and are the basis of all communication, whether linguistic or not. Semiotics studies the processes that lead signs to have particular meanings, and the ways in which such meanings are communicated and have effects. In many ways, semiotics can be seen as the most fundamental of the social sciences since it underlies all communication and social action. Moreover, by its nature, semiotics has to consider both individuals, as senders and receivers, and technology as the medium in which signs are embodied and transmitted, and thus relates to all three worlds.

In recent history, semiotics¹ has two significantly different lines of development, one traceable to Ferdinand de Saussure (1960 (originally 1916)), a Swiss linguist, and the other to Charles Sanders Peirce (1931-1958), an American philosopher and scientist. Both lines lead to very modern philosophers/sociologists – for example, Derrida and Giddens on the one hand, and Habermas on the other. In this paper we shall primarily be drawing on Peirce’s approach. We do so because Saussure only considered signifier (the sign) and signified (meaning) leaving out the world of the referent – a critical omission and a strong reason for preferring Peirce’s approach, and eschewing Saussurian-based post-structuralist uses of semiotics. Moreover, as we shall see, Habermasian and critical realist thinking are informed by Peircean semiotics, enabling, between the three, a more aligned theoretical and philosophical integration².

¹ Good source material includes (Chandler, 2002; Krampen, Oehler, Posner, Sebeok, & von Uexkull, 1987; Martin & Ringham, 2006; Noth, 1990)

² Thus Bhaskar (1993) explicitly acknowledges the centrality of the semiotic triangle to any adequate theory of meaning. Following Peirce, Morris (1938) characterized semiotics in terms of three dimensions: *syntactic* which studies the relations between signs and other signs; *semantics* which studies the relations between signs and their objects; and *pragmatics* which studies the uses of signs by their interpreters. This trichotomy formed the basis of Habermas’s communication theory (Habermas, 1979b).

3. Philosophical Underpinnings: Habermas and Critical Realism

3.1 Habermas and the Three Worlds

Habermasian critical social theory (CST) has a long, if somewhat marginal, history within IS. Perhaps the first to draw attention to the potential of critical theory within management and IS was Mingers (1980) who contrasted it with soft systems methodology (SSM) (Checkland & Holwell, 1998). It was later proposed as a foundational philosophy for IS research, in contrast to positivism or interpretivism by Lyytinen and Klein (1985), Klein and Lyytinen (1985) and Hirschheim and Klein (1989). This led on to the development of CST-based research methodologies (Cecez-Kecmanovic, 2001; Hirschheim & Klein, 1994; Laughlin, 1987; K. Lyytinen, 1992). More recently, Mingers and Walsham (2010) and Ross and Chiasson (2011) argued for the importance of Habermas's discourse ethics within information systems research. The theory of communicative action (TCA) (Habermas, 1984, 1987), which developed out of the earlier theory of knowledge-constitutive interests (Habermas, 1978), argues that the most fundamental characteristic of human beings as a species is our ability to jointly coordinate our actions through language and communication; and further that the ability to communicate is grounded on the capacity to understand each other. Thus the primary function of communication is the construction of understanding and then agreement about shared activities. Humans do, of course, engage in other activity: for example purposive instrumental action in solving a problem or reaching a goal; or strategic action where communication is used to achieve personal ends through some form of deception or control. But even in this latter case, understanding is a necessary prior condition.

Habermas therefore sees communication oriented towards reaching agreement as the primary, and most common, form of communication, and proposes that the principal means of reaching agreement is through rational discussion and debate - the "force of the better argument" - as opposed to the application of power, or the dogmas of tradition or religion. Habermas elucidates the nature of a "rational" argument or discourse in terms of two concepts: i) that contentions or utterances rest on particular validity claims that may be challenged and defended; and ii) that the process of debate should aspire to being an "ideal speech situation."

Whenever we actually say something, make an utterance, we are at least implicitly making claims that may be contentious. These validity claims are of three types, and each one points to or refers to an aspect of the world, or rather analytically different worlds. These three are:

- **Truth:** concerning facts or possible states of affairs about *the material* world
- **Rightness:** concerning valid norms of behavior in *our social* world
- **Sincerity** (truthfulness): concerning *my personal* world of feelings and intentions.

This approach was originally developed in Habermas (1984, pp. 75-101) where he argues that relationships to these three worlds are inherent in the social scientist's concept of action, and also in ordinary, everyday communicative action by speakers and hearers.

Habermas comes to this conception by considering four distinctively different types of social action – teleological, normatively-regulated, dramaturgical and communicative. Teleological action is purposeful action designed to bring about a certain state of affairs in the objective or material world. It is the classical form of action underlying traditional economic theory based on a choice between alternative courses of action in order to realize some objective. This form of action presupposes the existence of an objective world of entities and states of affairs that exist or could be brought about through purposeful action.

Normatively-regulated action, by contrast, concerns behavior that orients itself towards the agreed and valid norms and expectation within a social group. Thus particular behaviors are deemed to be acceptable or unacceptable within a particular context or set of circumstances. Norms have a binding force to the extent that actors agree that they are valid or, put the other way, when actors agree that they are valid they are thereby part of the social group. Thus the social world, for a particular social group, consists of a system of norms against which individual behavior can be judged to accord or deviate, and which in turn need to be justified as deserving to be seen to be legitimate.

The third form of action Habermas calls dramaturgical action in which the subject relates to the subjective or personal world. This consists of the totality of subjective states of an individual to which that individual has privileged access but only insofar as these could be, or

are, actually presented to others. The most obvious theoretical perspective is Goffman's (1969) "Presentation of Self in Everyday Life". The key validity question here is to what extent do others judge that the presentation is in fact sincere – i.e., is a proper reflection of the subject's actual subjective states? Here, there is a significant difference from the other two worlds in terms of the extent to which verification can take place. The objective world consists of material states of affairs that are the same for all and against which propositions can be tested for truth or falsity. The social world consists of norms against which actions can be tested in terms of their correspondence or violation. But in the subjective world, other actors have no access to the actual subjective states of the individual and so judgments of sincerity or truthfulness are perhaps harder than those of truth or rightness.

3.2 Critical Realism

As we saw in the introduction, human communication covers two potentially distinct domains – the social and conceptual on the one hand, and the physical on the other – and with Habermas we have brought in a third domain – the personal world, so it is important that these can be reconciled philosophically. For this reason, we begin by locating our work within the critical realist (CR) paradigm which accepts the ontological reality of a variety of different entities, be they physical, social, cognitive or abstract (Archer, Bhaskar, Collier, Lawson, & Norrie, 1998; Bhaskar, 1978, 1979, 1993). Such entities do not need to be measurable, or even directly observable, so long as we can postulate that they have causal effects. CR has been advocated as a philosophy for IS (de Vaujany, 2008; Dobson, 2001; Mingers, 2004a, 2004b, 2004c; Mutch, 1999) and used in empirical research (Bygstad, 2010; Iannacci & Hatzaras, 2012; Longshore Smith, 2006; Volkoff, Strong, & Elmes, 2007; Wikgren, 2005; Wynn & Williams, 2008) so we will only highlight the aspects relevant for this framework.

The first is the distinction between the *transitive* and the *intransitive* domains of science and knowledge. Science (and social science) is a human activity and therefore much of it is a social production – theories, experiments, papers, journals, debates etc. – are all human-dependent, and therefore transitive. However, the *objects* of knowledge, that which knowledge is *about*, are external and independent of our knowledge of them – they are intransitive. This is not only true for the physical world, where it seems uncontroversial that

physical laws would operate even if humans did not exist, but also for the social world, even though social laws and mechanisms can only operate in and through people in general. Even speech can become intransitive once it has been uttered and become detached from the circumstances of its production.

Second, there is a distinction between the *real*, the *actual* and the *empirical*. The real, that is, everything there is, consists of enduring structures and mechanisms that have particular tendencies and powers generating causal effects in the world. These structures, which may be unobservable and may not exercise their powers all the time, interact with each other and generate the actual events that do (and do not) occur. Some of these events are observed and experienced, and have the potential to become the empirical data of science. Both the actual and the empirical are part of the real and have causal effects of their own. CR also emphasizes the idea of *generative causality* in opposition to the Humean version of a constant conjunction of events. CR is also comfortable with the view that reasons can be causes, that is, that the reasons an actor gives for their actions may be an adequate explanation, although we must always be aware of unknown or perhaps unacknowledged conditions of action.

With regard to semiotics, critical realism has already recognized its importance although it is not that well developed. Bhaskar himself says that “the centerpiece of any adequate theory of meaning must be the semiotic triangle” (Bhaskar, 1993, p. 222-223), where his triangle consists of signifier, signified and referent. In this, it is clearly invoking Peirce rather than Saussure with its inclusion of the referent or object of the sign. In fact it can be seen as a simplified version of Peirce’s scheme (Nellhaus, 1998): the signified, or interpretant belongs in the transitive dimension while the referent or object is part of the intransitive dimension. In fact, Nellhaus argues that Bhaskar’s ontological domain of the empirical – those events that we actually observe and experience - should be re-conceptualized as the domain of semiosis.

Important for our theoretical approach is CR’s insistence that semiosis cannot be reduced either to the play of signifiers, as with Saussure or Derrida, or to a purely hermeneutic sphere (Fairclough, Jessop, & Sayer, 2004). Semiosis must always have external referents, and extra-semiotic conditions and consequences: “semiosis presupposes embodied, intentional, practically-skilled social actors, social relations, material objects, and spatio-temporality”

(Fairclough, et al., 2004, p. 28) not to mention the technology that both enables and conditions communication. We will call this “material semiotics” to use a term from Haraway (1988) and Law (1995).

4. Integrating Peircean Semiotics

Having established the broader framework, we now need to delve into the actual processes of communication and signification that underlie these three worlds and their inter-relations. We will do this in three stages: first we will describe the processes of semiosis through the work, primarily, of Peirce. Second we will clarify the nature of information as it is represented, stored and transmitted semiologically, and show that the *information* carried by a message is not necessarily the same as the *meaning* of the message, or the *meaning* of the information for a receiver. Information is objective and true; meaning is subjective and potentially true or false. Finally, we will outline the process whereby humans process information and meaning, and come to act upon it, as one of *embodied cognition*.

4.1 Peircean Semiotics

For Peirce(1931-1958)³, a sign involves a triadic, as opposed to Saussure’s dyadic, relation between a *representamen* (signifier), an *interpretant* (signified) and an *object*– see Figure 1.

A sign ... {representamen} is something which stands to somebody for something in some respect or capacity. It addresses somebody, that is, creates in the mind of that person an equivalent sign, or perhaps a more developed sign. That sign which it creates I call the *interpretant* of the first sign. The sign stands for something, its *object*. It stands for that object, not in all respects but in reference to a sort of idea, which I have sometimes called the ground of the representamen. (Peirce, 1931-1958, 2.228, original emphasis)

³References to Peirce are to volume and paragraph in the collected works published much later. Most of his writings were between 1880 and 1910. We should note that Peirce wrote extensively about semiosis over many years, often developing or changing his terminology, so there is not a single model or theory. Other sources are Buchler(1940), Almeder(1980) and Greenlee (1973)

Peirce was primarily interested in the *process* of semiosis, that is, the way in which signs were continually interpreted and re-interpreted within the process of communication. Considering Figure 1 in more detail, the representamen is the physical manifestation of the sign – its form as opposed to its content (properly speaking “sign” should only refer to the whole combination of the three aspects but sometimes it is used to refer just to the representamen). The representamen brings with it two effects – the entity that it represents, and the idea that it generates in an interpreter. The interpretant is not the interpreter *per se* but does imply that there is some form of interpreter. The interpretant is seen by Peirce as another sign thus leading to the idea of continual semiosis. These two effects can be seen as the same as Frege’s (1952) distinction between sense and reference. The “meaning” of a sign thus consists in both its sense and reference. The entity is that which the sign stands in place of, and can be physical, mental, imaginary or another sign.

Peirce developed these basic categories in several ways (Noth, 1990). He produced complex typologies of different types of representamen. The main one distinguished between icons, indexes and symbols in terms of their relationship to the object. Icons are signs that resemble
or

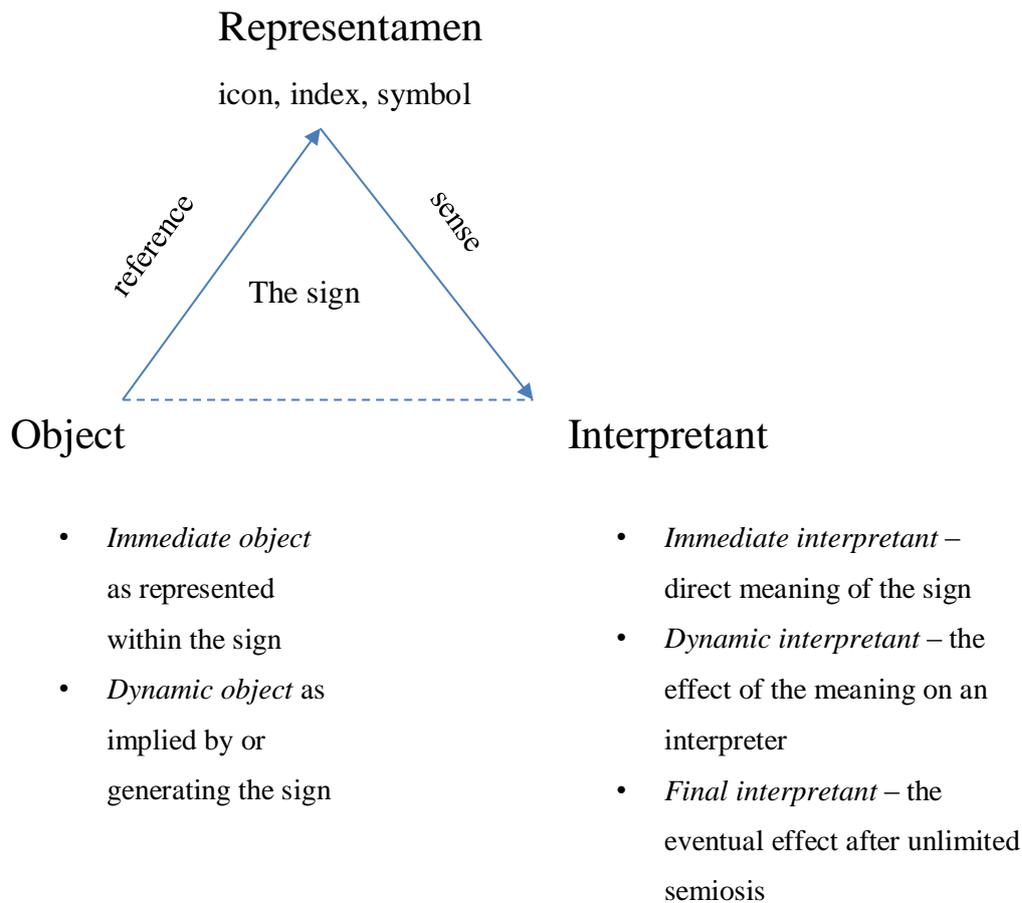


Figure 1 Peirce's Semiotic Triangle

imitate their objects in some way, for example a picture, a model, or a simulation. Indexes relate to their objects directly, either causally or temporally. For example, a thermometer is an index of the temperature; the sun setting is an index of nighttime coming. Symbols have no direct relationship to their object at all; the association is purely conventional as in language or mathematical notation. Symbols have a relationship purely through the habit of their association.

Peirce was very concerned with the way in which signs came to be interpreted in practice (Almeder, 1980). For the interpretant, he distinguished between the immediate interpretant and the dynamical interpretant⁴. The immediate interpretant is the “quality of the impression

⁴He also talked of a final interpretant but was somewhat unclear about what this meant. He also sometimes talked of the emotional/energetic/logical interpretants but there is debate about the relationship between the two schemes (Atkin, 2006)

that the sign is *fit* to produce and does not consist in any actual reaction” (8.315). It is thus the intrinsic meaning or interpretability of the sign *before* anyone has actually interpreted it. The dynamical interpretant is the “direct effect actually produced by a sign upon the interpreter of it” (CP 4.536). This is the idea or meaning that the sign generates in a particular person, related to the object represented by the sign. It is, therefore, in part dependent on the interpreter and may differ from one to another. It also generates some effect in the interpreter, whether a physical action, or a mental one such as *another* sign, which may in turn be expressed in a representamen. Thus we have the process of semiosis or signification.

Peirce also distinguished two forms of the object of the sign, also called the immediate object and the dynamical (or mediate) object:

“We have to distinguish the immediate object, which is the object as the sign itself represents it, and whose being is thus dependent upon the representation of it in the sign, from the dynamical object which is the reality which by some means contrives to determine the sign to its representation” (CP 4.536).

This very important distinction commits Peirce to at least some form of realism, although not a naive realism. The immediate object is that which is contained within the sign, and picks out certain aspects or grounds of the “real” object – the dynamical one. The latter is the underlying, but not immediately present, trigger of the sign.

To illustrate these concepts with an example, if someone asks “Where is the bathroom?” the immediate object is the concept of a bathroom as expressed in the sign. In this case it is just a bathroom in general, not a particular one. The dynamical object is the actual bathroom (assuming there is one), with all its particular characteristics, which exists outside the world of the sign. The immediate interpretant is the meaning of the question as a whole that any speaker would understand, and the dynamical interpretant is the effect the question has on an interpreter which may lead them to give directions or ask someone else.

Semiotics was only a part of Peirce’s extensive philosophical thought. We should also note for later that he was one of the founders of American pragmatism (Buchler, 1940; Peirce, 1878),(CP 5.411, 5.197, 5.597)] and thus his theory of meaning was built on his semiotics. Expressions gain their meaning through their conditions of use, i.e., the effects that they have

on the world, which is precisely the dynamical and final interpretants of a sign or message. Less well known is that he was also a phenomenologist (Buchler, 1940), (CP 1.284-7, 1.536-7), to some extent pre-dating Husserl (1973 (orig. 1913)), and developed a theory of three modes of being: *firstness* – pure quality or actuality in itself; *secondness* – relations between one thing or quality and another; and *thirdness* - cognition, concepts and laws about firstness and secondness. The sign embodies all three modes.

One area not developed by Peirce was the physical or technological aspects of semiotics and communication, which is manifestly of importance for this paper, and so we consider some later developments as we develop our framework (Figure 1 in section 4).

Morris (1938) developed semiotics as the science of all signs to include non-linguistic and non-human sign processes. He characterized semiotics in terms of three dimensions: *syntactics*, *semantics* and *pragmatic*. Syntactics, or syntax, covers all the formal relations between signs, including the rules of language, or the sign system. Semantics is a polysemous term that is closely related to meaning. Initially, Morris saw it as specifically the relations between the sign and its object, i.e., reference or denotation, but later included the sense, or immediate interpretant, of the sign as well. Pragmatics covers “the origin, the uses and the effects of signs” (Morris, 1938, p. 30) which would include the biological, psychological and social aspects of the intentional use of signs and formed the basis of Habermas’s universal pragmatics (Austin, 1962; Habermas, 1979b; Searle, 1969)⁵.

In another development relevant for this paper, Jakobson (1956) saw that Saussure’s distinction between the *syntagmatic* and *paradigmatic* axes was essentially based on the difference between metaphor and metonymy or, more basically, similarity and contiguity. A

⁵ Later work within information systems by Stamper (1997) extended Morris’s typology. Below the level of syntactics, Stamper added the *material* level of physical phenomena that allow the storage and transmission of signs, and the *empiric* level which concerns the effective and efficient transmission of messages as is dealt with by traditional information theory (Shannon & Weaver, 1949). He also added an upper level – the *social*- that went beyond individual intentionality to the effects of signification in the social and organizational worlds (Stamper, 2001).

metaphor is a figure of speech, or trope, in which one element (or signified) stands for another on the basis of some similarity or likeness (e.g., “the university of life”). Metaphor is incredibly common in language. Indeed, Lakoff and Johnson (1980) argue that the origin of almost all language is metaphorical in relation to our basic physical experience of the world. Metonymy is another trope in which one signified stands for another on the basis of a direct relation, e.g., part/whole, cause/effect or substance/form (e.g., “I spy the sails”, “The mercury’s through the roof”). In this, it is very similar to Peirce’s indexical type of sign. So a sign gains meaning through a combination of likeness and contiguity.

Jakobson also developed a model that applied to any speech or communicative act (Jakobson, 1960) comprising of six components or elements, each of which leads to a different function of language. These are: the *addresser*, the *addressee*, the *context*, the *message*, the *code* shared by addresser and addressee), and the *physical or psychological contact* to transmit the message. These influenced Habermas (1994) as underpinning for his theory of communicative action.

4.2 Semiotics in Business and Information Technology

Semiotics has been used in a range of business areas particularly, as might be expected, in marketing, for example: Mick (1986), Arnold et al (2001), Harvey (2001), and Lawes(2002). In other domains, Barley (1983) used semiotics as a way of studying the systems of meaning within particular occupations; Fiol(1989) analyzed CEO’s letters to shareholders to understand a company’s propensity to enter in to joint ventures; Brannen(2004) studied the cultural differences that can undermine an organization’s transfer of policies and process abroad ; and Cooper et al (2001) used semiology to decode the reviews of regulated utility companies produced in the UK.

Moving to IS and IT, a considerable body of work has developed around Stamper’s (1991) extension of Morris’s (1938) framework, discussed in more detail below. This work generally goes under the name “organizational semiotics” (Gazendam, Jorna, & Cijssouw, 2003; Liu, Clarke, Andersen, & Stamper, 2001, 2002a, 2002b) but it mainly concerns information systems and systems analysis.. Work within this tradition is generally based on Peircean

semiotics and ranges from studies of instrumentation and the human-computer interface (HCI) (May & Andersen, 2001) through the development of information systems having regard to both their technical and human aspects (Stamper, 2001) to studies of IS within their organizational context (Clarke, 2002). There are other sources used, for example, Robichaud (2002) employs Greimas's (1983 (orig 1966)) narrative grammar to analyze a process of public consultation in a Canadian city, and Kryssanov et al (2003) use Luhmann's(1986) autopoietic social theory in user interface design.

Moving away from Stamper's framework, there are several semiotic analyses of ICT as a communicational tool. For example, Warschauer and Grimes (2007) analyzed Web 2.0 type software such as blogs, wikis and social networking sites in terms of semiotic constructs such as authorship, audience, and artifact. Tredinnick (2007) also used post-structuralist semiotics (e.g., Barthes, Foucault, Derrida) to study the effects of hypertextuality in the WWW. Menchik and Tian (2008) used Peirce's and Morris's semiotic frameworks to analyze the ways in e-mail users overcome the exclusion of non-linguistic cues and gestures in e-mail interactions. Mancini and Buckingham Shum (2006) discuss a discourse representation system, based on semiotics, specifically for domains of debate and contestation such as academic discourse. Price and Shanks (2005) developed a framework based on Peircean semiotics to assess information quality involving both objective and subjective perspectives while Rosenkranz et al (2013) used semiotics in evaluating the quality of the language used within studies of requirements development.

Semiotics leads to the nature of information itself being a key issue. First there is the relationship between information and meaning – is the information carried or contained in a message the same or different to its meaning? Second, there is the question of how information is embodied or represented symbolically in sign systems, and how it is transmitted. These are both core topics within semiotics. Mingers (1995a, 1996) proposed a theory of information, based on semiotics, that explicitly differentiated information from meaning. This leads us on to consider how information actually gets translated into meaning, and then how meaning and information are transmitted. Mingers argues that this occurs through a process of embodied cognition (Mingers, 2001) and this will be developed further in the theoretical section of the paper. Others who have approached information from a

semiotic perspective include Beynon-Davies(2009a, 2009b; 2010), Huang (2006), Brier (2001), (Baskerville, 2010), Raber (2003) and Price (2005).

The final area we shall discuss is the human-computer interface (HCI) where signs and symbols obviously play a central role. Here, Anderson (1990) coined the term “computer semiotics” by which he meant adapting the semiotic theories that had primarily arisen in linguistics to the specific domain of computing. In particular, he drew on both the structuralist tradition of semiotics as represented by Barthes and Eco (Ramussen, 1986), and the phenomenological/speech acts approach as represented by Winograd and Flores (1987). However, for the purposes of this paper we wish to highlight a more recent trend that goes beyond structuralism or phenomenology to encompass the idea of embodiment. De Souza (2005) has developed a theory of semiotic engineering which sees HCI as enabling an active communication process between the system user and (implicitly) the system designer, and O’Neill (2008) has built on these ideas. This strand of thought will form part of the theory developed below..

5. Information and Meaning

From the perspective of information systems, we need to consider how signs and symbols get translated into action (embodied cognition) and how actions and information get transmitted (technology). As a first step we will consider the relation between meaning and information. Are they in fact the same, so that the meaning of a message is the same as the information it conveys? Or are they distinct, in which case how do they relate to each other?

A semiotic theory of information can be developed (Mingers, 1995a, 1996, 2013) combining ideas from Dretske (1981), Habermas (1984), and Maturana (1980). Similar ideas have been proposed recently by Floridi (2005, 2011). Following Bateson (1973), the foundation of information (data and more generally signs) must be differences in the physical world, for without difference there is only uniformity. More particularly, differences that “make a difference”, that is, generate an event or a sign. Events carry information because the occurrence of an event reduces the possibilities of what might happen to what actually does happen, as Shannon and Weaver (1949) argued. In particular, an event (which includes a sign

or message) carries the information about what caused it, or led to it. That is, what must be the case in the world for the event to have occurred? Such information exists *independently of any observer*, indeed, it might never actually be observed⁶. Nevertheless it carries with it the information concerning its own genesis.

Information can also be transmitted provided that there are causal links between the sender and the receiver (not necessarily people). This occurs to the extent to which states of the sender are correlated or connected to states of the receiver. Independent events transmit no information; completely linked events transmit all information. Most situations are between the two extremes – the receiver can be affected by things other than the sender (*noise*), and not all of the information from the source will affect the receiver (*equivocation*). We note also that, following Bhaskar (1993), absences can be causes and therefore can generate information. So the gas bill that is not paid by the due date generates information to that effect for the company, which then triggers a reminder letter.

Information is, then, clearly defined – semantic information⁷ is the *propositional content of a sign*, that is, what is implied about states of affairs in the world given that the sign exists. This definition has several consequences:

- Information is an objective commodity – it is carried by events and signs whether or not it is observed or extracted, and information can be stored and transmitted by the environment, artefacts and people.
- Information is distinct from its embodiment in a sign or message since the information itself can have causal events – a knock on the door leads us to open it not because of the physical knock, but because it carries the information that someone is there.
- The amount of information that is available to a particular receiver depends on their prior state (often knowledge) relative to the sign. A book in Chinese has no available information for someone who does not read Chinese. Signs about a car not starting will have much more information available for a mechanic than someone who is only a driver. This does not contradict

⁶ In Bhaskar's terms, differences and information exist in the domain of the actual, but if they are observed they become empirical.

⁷In terms of Stamper's typology, we are interested in the semantic, pragmatic and social levels.

the idea that information is objective – if someone does not know the combination to a safe the money inside is not available to them but still exists.

- Information must be true. We may misunderstand or misinterpret a sign but the sign itself only carries true information.

This theoretical conception allows us to specify clearly terms which are often contested within information systems:

- *Data* is a collection of signs, usually brought together for some purpose, to store or transmit information. They are usually numeric, pictorial, linguistic or gestural.
- *Semantic information* is the propositional content of data, typically in the form of a message but also in the form of a naturally occurring sign.
- *Meaning* has two different usages. First there is the system of meanings that are publically available within a sign system such as language (Peirce's immediate interpretant). These can be drawn on by competent language users in their communications (Habermas, 1979a). It is that which allows an utterance to carry information but it is not identical to that information. The second usage is the "meaning" that the recipient gains from an utterance (Peirce's dynamic interpretant) and/or that which the sender intends. If the meaning that the sign has, its connotation, is in fact true – i.e., the state of affairs that is described or implied - does in fact exist, then connotation is also information. If it is not true, the sign may be meaningful but it will not carry information.

This draws a clear distinction between information and meaning. Information is *objective*, in the sense of being independent of the sender or receiver, and must be *true* to be information. Meaning is intersubjective, in being at least partly dependent on human interpreters, and is generated from information. Thus, information systems, which store, process and transmit information, are only a part of wider systems of meaningful human communication.

5.1 Illustrative example: Khipu, information and meaning

Beynon-Davies (2010) has usefully refocused our attention on a narrower, and neglected, concept of information system by providing an example from 13th to 16th century Inka culture, thus defamiliarising our notions within a different era and set of technologies. The Inka 'bureaucracy' sent and received many messages daily in support of the activity of the empire. Typically, such messages contained details of resources such as items in store houses, taxes owed or collected, census data, and the output of mines or the composition of particular

workforces. Messages had to be clear, compact and portable. For this purpose the khipu was used, consisting of an assemblage of colored, knotted cotton or camelid (llama or alpaca wool) cords. The use of weaving and textiles for both tool-making and communication have deep roots in Andean culture. The khipucamayuc (keeper of the khipus) were responsible for encoding and decoding the messages. Encoding or 'writing' a khipu involved tying together a complex network of cords of different materials and colors, and adding to them a series of different forms of knot. Decoding or 'reading' a khipu involved a khipucamayuc, both in visual inspection and running his fingers rapidly over the knots. It would seem that khipu were used by the Inka as a three-dimensional sign-system in which data were recorded by tracing figures in space with pieces of cord. In this way information was relayed and meaning gained through reference to the pre-set symbolic meaning system.

Beynon-Davies (2010) utilizes the semiotics ladder of Stamper (2001) in terms of the physical/ empiric, syntactic, semantic and pragmatic (social) layers. At the level of empirics (data system), khipu can be considered purely as physical artefacts. First, the maker of khipu would consider the construction of cords. Then he would consider the placement of cords upon other cords. This would be followed by choices concerning the construction and coloring of knots – a palette of some 60 colors - as well as the placement of knots upon cords.

At the level of syntactics (information system), physical elements of khipu can be considered as symbols and specified in terms of some data model. There is evidence for the knot as being the fundamental symbolic element within khipu. The construction and positioning of knots relative to each other upon a pendant cord can be seen to constitute a datum. A related collection of knots upon a cord – a knot group – constituted a data item. The collection of knots within a knot group serves to value the data item. A group of pendant cords would constitute a data element and the entire assemblage of cords within a khipu constituted a data structure.

At the level of semantics (information system), Beynon-Davies suggests that knot groups tied on pendant cords within certain khipu represent numbers to the base 10 (decimal). Particular knot types such as single, figure of eight and long knots and their positioning upon pendant cords signify distinct numbers. The closer the knot to the top of a cord: the higher the number. At the very top a single knot represented multiples of 10,000, then 1000, then 100,

then 10. Knots tied to pendant, subsidiary or tertiary cords could be used to signify numerals or magnitudes of things. However, numbers could be used as ‘labels’ denoting other referents, such that a given knot group on a khipu can be considered as similar in nature to a modern bar code, with individual knots substituting for the bars of the code.

In terms of pragmatics (the activity system), khipu need to be understood as part of the information systems within which they were used and the activity systems they supported. Khipu only makes sense in the context of the information specialists of the khipucamayuc; the chaski - highly trained runner/messengers as part of the Inka transport network; the tributary systems of the Inka and their need to manage the distribution of labor throughout the empire. Therefore, a number of activity systems of the Inka Empire such as tax collection, the administration of workforces in the building of collective works and the distribution of goods within the Empire relied on an effective system of communication. There is clear evidence of the use of khipu for the keeping of records within wider communication systems, for example accounting, provincial census and personal status records, with data flowing throughout the administrative hierarchy.

Beynon-Davies’ case usefully illustrates what he calls ‘the enactment of significance’, while supporting our view that it is necessary to distinguish between the (intersubjective) system of signification and representation that allows messages to be transmitted; the (objective, i.e., true) information that messages can transmit; and the (subjective) meanings that generated by the information and its representation. The case also provides some critique of any strong sociomateriality, ‘entanglement’ perspective by disaggregating the units for analysis, and by arguing that the term information system is overloaded, with the focus too often on the IT artifact and organization, thus downplaying the role of the information system, and how significance is enacted through processes of semiosis.

6. Processing Meaning: Embodied Cognition

We now move to the process by which messages come to be interpreted, reacted to and acted on to generate technologically-based communicative interaction. In contrast to the traditional cognitivist, representationalist paradigm, we shall adopt the perspective of cognition as an active, embodied phenomenon (Mingers, 2001). This draws on the phenomenology of Heidegger (1962) and Merleau-Ponty (1962, 1963), autopoiesis (Maturana & Varela, 1980; Mingers, 1995b; Varela, 1991), and work within ICT such as Winograd and Flores (1987), Dourish (2001), O'Neill (2008), Schultze (2010) and Schultze and Orlikowski (2010).

The essence of this position is to deny the Cartesian split between mind and body so fundamental in disciplines such as artificial intelligence, computing, information and cognitivist psychology, in favor of one that recognizes the essentially embodied nature of human cognition whether at the level of perception, thought, behavior or language. This is also the position underscored by the work of Johnson (1987) and Lakoff and Johnson (1980), including their emphasis on reason shaped by the body, a cognitive unconscious to which we have no direct access, and metaphorical thought of which we are largely unaware.

As autopoietic living systems we have a nervous system that is organizationally-closed and self-referring, but which is interactively open to the environment. The type and limitations of these interactions are shaped primarily by our own nervous system rather than by the environment (structure-determined). External events, e.g., messages with information, trigger responses but the nature of the response is determined by the readinesses of the nervous system at the time – indeed the system determines what can be triggers for it. The transformation of information into meaning (digitalizing the analogue) is carried out largely unconsciously by the body presenting our conscious mind with pre-structured meanings⁸. This is the process of embodied cognition.

“There is not *thought* and *language* ... Expressive operations take place between thinking language and speaking thought; ... It is not because they are parallel that we speak; it is because we speak that they are parallel ... I do not speak *of* my thoughts; I *speak* them and what is between them.”(Merleau-Ponty, 1964, p. 18, orig. emphasis)

⁸Much of this was recognized by Peirce who saw that semiosis worked on the basis of “habits”, both mental and physical, which enables us to process and act on signs.

This is not to say that the meaning triggered by signs and symbols is completely arbitrary or subject-dependent. The very fact that they can trigger anything in the nervous system reflects the way in which we are socialized to the wider social system within which connotative systems exist. We, as human beings, are “structurally coupled” with our immediate environment of people, signification systems and materials. We can say that signs act as affordances and constraints – they tend or afford to lead to particular interpretations and constrain against others – but this is always relative to the knowledge and intentions of the receiver.

On one view, the interpretation of signs can be seen in terms of three stages, illustrated with an example (from Peirce) in Figure2 (Mingers, 1995a).

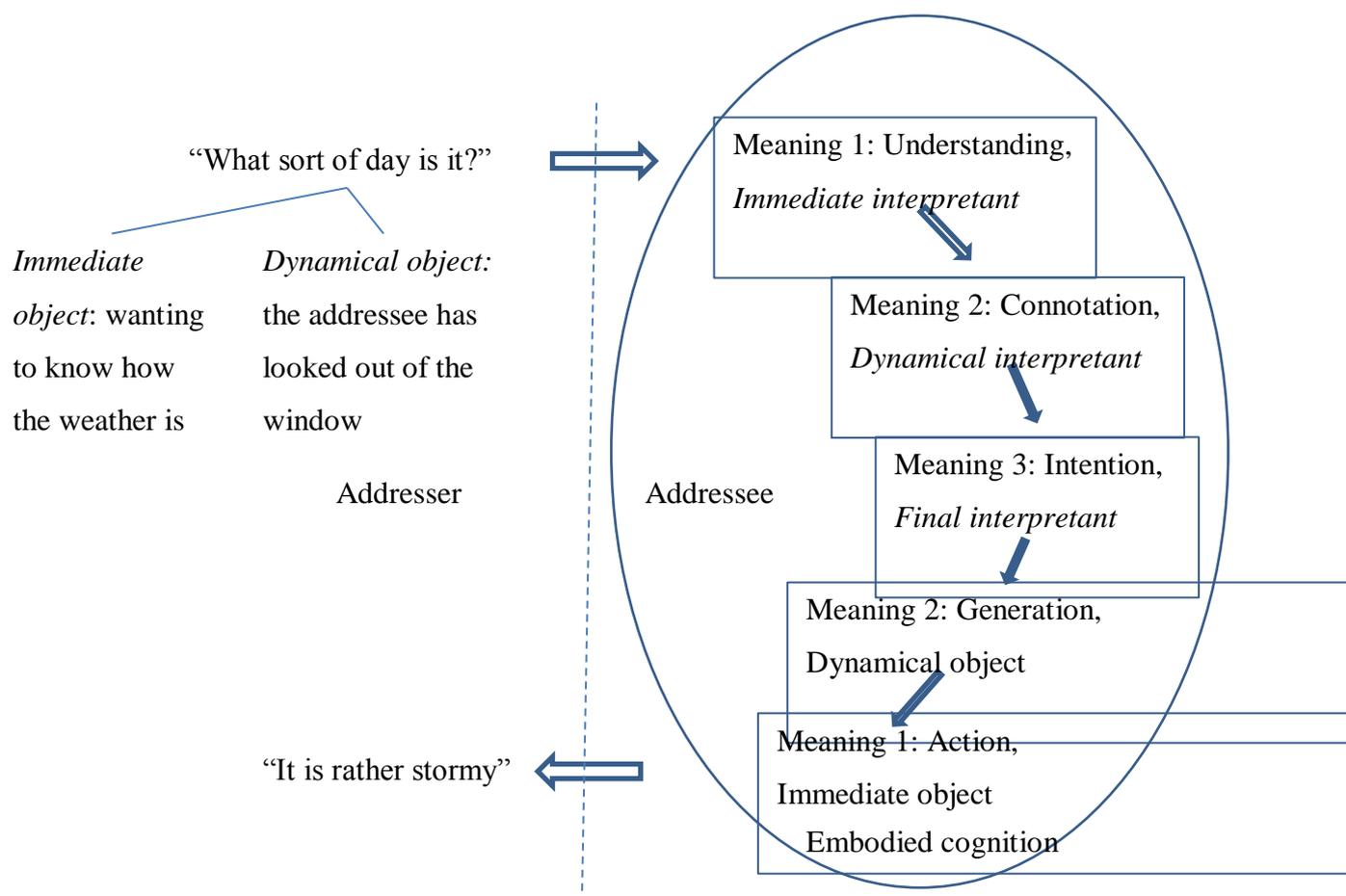


Figure 2 Stages in the Interpretation of and Response to Signs

Suppose the addresser sees the addressee look out of the window at the weather and asks what it is like. In Peirce's terms, the immediate object is wanting to know the current weather, the dynamical object is the fact that the addressee has looked at it. The first stage of interpretation (understanding or immediate interpretant) is simply appreciating the general meaning of the message, what any competent speaker of the language would be able to do. This will be done sub-consciously by the body and nervous system (what Heidegger would term "ready-at-hand") unless there is some degree of ambiguity in which case the message may become more an object of conscious reflection ("present-at-hand").

The second stage (connotation or dynamical interpretant) brings in the individual knowledge and motivations of the addressee. It is the effect of the message or sign on that person; it is the process by which the semantic information carried by the message is transformed into meaning. This stage is not purely individual but socially structured in terms of the addressee's forms of life (Wittgenstein, 1958). Finally, the third stage (intention or final interpretant) leads to some form of action or result which could be a reply, or an activity, or just a decision not to respond. In any event, the addressee's state of readiness will be changed in some small way. Where some physical action such as a reply is involved, there will be a similar set of stages involved in the production of a response. The whole of this process is one of embodied cognition in that much of it happens beneath the level of consciousness, carried out through the structure of the body and nervous system.

It is at this point that we can bring in technology, or perhaps in this context it is better to call it media – "the material of the world that affords the mediation of some form of content" (O'Neill, 2008, p. 138). Or, as Dourish (2001), who is concerned with tangible and social computing, has said:

"Tangible and social computing both capitalize upon our familiarity with the everyday world, a world of social and physical interactions. As physical beings, we are unavoidably enmeshed in a world of physical facts. ... So, the social and the physical are inescapable aspects of our everyday experiences." (p. 100).

6.1 Illustrative example: embodied interaction

As established earlier, semiotics has been widely applied already in the study of ICTs and business though this has not always been through utilizing Peircean semiotics. Particularly interesting, in the light of our emerging framework, is the work of Dourish (2001) and O’Neill (2008) who look at human computer interaction by drawing on phenomenology (Heidegger, 1962), Merleau-Ponty’s (1964) work on embodiment, and semiotics to develop the notion of embodied interaction. They are particularly interested in how interactive media can be studied and designed, taking into account the physical and social worlds in which they operate, and how media and technologies relate to the human beings interacting with them. Our framing plays directly into such work. As one example, O’Neill (2008), who at one point talks of the ‘semiotic screen’, refers to the Brazil-based SERG group that draws heavily on Peirce’s conception of a sign to develop their understanding of signification with interactive media in screen-based interfaces. Here they find particularly useful Peirce’s concept of how signification takes place through “thirdness”, where a representation is related to its object via an interpretant (Prates, de Souza, & Barbosa, 2000). If this example seems to focus on the cognitive semiotic dimension of the Figure 3 framework, then these HCI researchers are also focusing on the embodied interaction of the personal and material, in a physical, human designed space. Dourish in particular also stresses the role of the social in HCI assessment and design processes, giving as an example the study of an air traffic control center by Hughes et al (1995).

6.2 Illustrative example: virtual worlds and meaning

We can pursue this further in the work of Schultze (2010) on embodiment and presence in virtual worlds. These are multi-modal platforms featuring rich graphics, 3D rendering, high-fidelity audio and video, motion and interactivity. Examples include *Second Life*, *Teleplace*, *EverQuest*, consisting of technology designed to create and experience virtual spaces, objects and people with which a user can interact. Schultze reveals a complex world where avatars re-embodiment the communicator who has been disembodied through computer mediation. Embodiment here means that the communicator can engage in practices of the body (e.g., smile, sit, move) and have a sense of presence whether in an actual or virtual environment. Semiosis pervades both the design process and features of the virtual world, but also how it is operationalized through social, personal and material interaction. As Schultze describes it, how the users constructs an avatar with regard to personality, appearance and behavior is imbedded in a system of meaning informed by the social norms and conventions shaped by

both the actual and the virtual world. Indeed Nowak and Rauh (2005) highlight some of the social norms of avatar appearance, with a humanoid gendered avatar being the first choice of self-representation, having the more likeable and persuasive qualities necessary to be effective in social settings. Here we can see the personal and social worlds interacting through sociation and semiosis, (which we develop below – see Figure 3) mediated by technology. One of the avatar’s key affordances is embodiment, in the sense of giving participants a virtual body that enables them to engage in practices of the body and recapture the body’s non-discursive, semiotic capabilities. Here we see the personal and the material interacting through embodiment and semiosis. This interaction is also performed to give experiences of *presence*. Schultze (2010) helpfully list six kinds of illusory presence – telepresence, social presence, co-presence, self-presence, hyper presence, and eternal presence – made possible through personal-material interactions. And, as we saw with Project Wonderland, virtual worlds can also be social worlds where sociomaterial and semiotic interactions link the social, the material, and emergent meanings and performance.

7. A Summary Integrative Framework - Semiosis and Three Worlds

We have now reached the point at which we can assemble and introduce the integrative semiotic framework (see Figure 3) that draws on all the material developed above. In Figure 3, semiotics is shown at the center of a triangle formed by Habermas’s (1987) three worlds: the personal, the social and the material worlds. But this framework goes beyond Habermas to consider both the relationships between the three worlds and the mediating role of semiotics within these relationships.

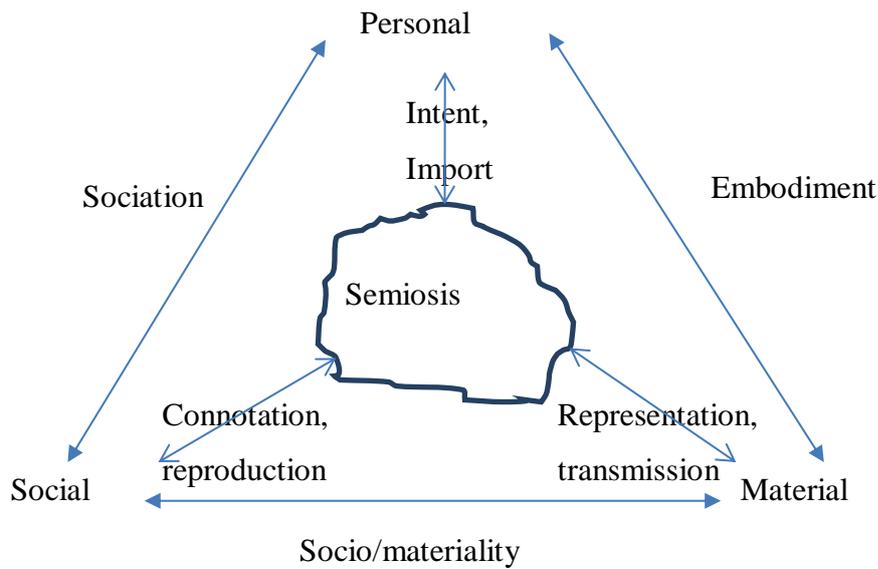


Figure 3 The Relations Between Semiosis and the Three Worlds

Let us consider first the interior of the triangle. Semiosis relates to the personal world, the world of the subject, in the ways outlined above through the generation and interpretation of signs and messages. As human beings we exist in a world of meaning and communication and that is always a process of semiosis. Events and symbols have meaning for us (import) because of what they represent or stand for and our communicative intentions (conscious and unconscious) can only become operative when represented in some form of sign system. We would want to stress again that meaning is to be distinguished from information. Information is that content of a meaningful message that is, in fact, true whether or not it corresponds with the meaning that the recipient actually derives from the message.

Semiosis also relates to the material world in that all signs have to have some form of physical embodiment in order to be signs, and they must also be transmitted through some form of physical media. By media we do not mean necessarily technology, although that is increasing our human mode of communication, but sight, sound, touch etc. are all media for semiotic communication.

Finally, semiotics relates to the social world in that the connotive aspects of sign systems are social rather than individual – they exist before and beyond the individual’s use of signs. Some semiotic interactions may be non-social, for instance taking hoof marks as a sign that a horse has passed by (an indexical sign), but the vast majority are symbolic and so rely on pre-existing agreements about the meanings of particular signs.

Looking next at the outside, each side represents an ongoing form of relationship between the corners. Between the personal and social worlds there is a relationship of what we might call sociation. This is essentially the relationship between structure and action that has been so heavily discussed and debated. From a critical realist position, the work by Bhaskar (1979) and Archer (1988, 1995; Mutch, 2010) on morphogenesis addresses this area. The social and the individual are conceptualized as two real, independent but mutually interlocking systems. Society is an “ensemble” of structures, practices and conventions realized in the form of “position-practices” – role positions and social practices. It thus pre-exists the individuals who occupy these positions and conditions that activities they undertake. But, at the same time, society is reproduced or transformed by that individual activity. Whilst emphasizing the ontological reality of social structures, Bhaskar accepts that they only exist through the activities they govern. An alternative conceptualization would be through Giddens’ (1984) structuration theory which is already well known within IS (Jones, 2008).

Between the personal and the material worlds we have a relation of embodiment. This occurs in two ways – the first is embodied cognition which is to do with the physical human body and the manner in which this inextricably links thought and action, as has been outlined above. The second concerns technology, taken very broadly, and the ways in which it both enables and constrains human action (Dourish, 2001; O’Neill, 2008).

Finally, between the social and the physical we have a relationship of socio/materiality as envisaged by, for example Orlikowski (2000, 2007), and (Leonardi & Barley, 2008; 2000, 2007; 2008). As we recognized in the introduction, there are in fact several different ways of conceptualizing the relationship between the material (i.e., technology) and the social: as one in which one side dominates the other; as one in which there is a mutual interaction between different or relatively systems; or as one in which the two systems are intrinsically

inseparable (which is currently called sociomateriality). Our position, from a critical realist perspective, would be the second one – i.e., independent but mutually interacting and shaping systems – rather than sociomateriality proper.

In fact, what we can see from this diagram is that the outside relationships - sociation, embodiment and sociomateriality - are in fact all mediated through the process of semiosis. Since, phenomenologically, humans always already exist within a space constituted through meaning, and semiosis is the process of production and interpretation of meaning, it is not possible to conceptualize these forms of interaction without involving semiotics.

8. Applying the Integrative Semiotic Framework: Two Cases

The relevance of the framework is not restricted to HCI studies. Recall our position that signification processes must be located in relation to the personal world of minds, intentions and knowledge; the social world of power and normative practices; and the material world of space-time, technology and bodies (Habermas, 1984). Here we illustrate the potential of the framework using two extant case examples.

8.1. TripAdvisor

Our first example is Scott and Orlikowski's (2009) analysis of the social media *TripAdvisor*. *TripAdvisor*, they record, is one of the largest online travel communities with over 20 million reviews and opinions stored on over one million hotels, restaurants and venues, contributed by some 30 million visitors per month. Scott and Orlikowski plot the transformation of how assessment knowledge of the industry is produced by studying two hotels. They find that *TripAdvisor* ranks them using the same algorithm, thus configuring them as rivals, though the hotels have different attributes, characteristics and, indeed, markets. There are also noticeable differences between the profiles of travelers posting their reviews of these two establishments. Postings can also be multi-media including images, e.g. photographs of rooms, level of cleanliness, window views. *TripAdvisor's* ratings reflect individual users'

personalized and situated experiences in a hotel, and their decision to provide a review. Unlike the more traditional Automobile Association (AA) ratings that focus on operational issues and standardized assessments of facilities, *TripAdvisor's* ratings are “temporally sensitive continually reconfigured, personal, and based upon relatively unregulated content” (Scott & Orlikowski, 2009). Not surprisingly hoteliers found the views and ratings often variable and subjective, but also felt unable to do much to change the type of knowledge being produced through this form of social media. Thus TripAdvisor, as a social media technology, gives the subjective reviews and ratings a determinacy and reach not otherwise achievable while also challenging the hoteliers’ and institutionalized hotel recognition schemes like AA’s primacy and control.

This exploratory study brings out several points that lie within the sociomaterial dimension of the Figure 3 integrative framework. But highly pertinent questions can be asked from the other two dimensions – the personal/technological and the personal/social. How do individuals themselves relate to the technology – in what circumstances do they use it? Why do they use it? Is it only very good or bad experiences that get recorded? What is their level of belief on the accuracy and reliability of the data provided? Is it the ease of access that determines use, i.e. convenience, rather than confidence in the information? Is the description of “actual” experiences more convincing than statistical data? What is the role of semiosis in seeking answers to these questions? Then there is the personal/social dimension i.e. sociation and semiosis - and how the personal influences the social ‘facts’ being created, and how these are then influencing personal decisions. Semiotically, how does social media like *TripAdvisor* change meaning, the flow of information, and create ratings and assessment as social ‘facts’? These sorts of questions raise issues about the creation, interpretation and response to signs, and the role of signs in creating a continually remade and contested social and personal reality.

8.2 Dairy production plant

The second example – the study of a fully computerized dairy production plant by Kallinikos (2011) - is particularly alive to the role of signification in seeking to understand how ICTs interact and help change the material and cognitive foundations of work. He points out that,

as ICTs proliferate, they bring with them symbol schemes and codes that do not rely on the signifying conventions of similarity and proximity (Peirce's indexical signification). This can create real difficulties in sense-making, and explains to a degree the attempts in our previous examples to technologically create similarity and proximity for social and personal use e.g. in the Project Wonderland and avatar examples. Kallinikos points to computer technology bringing to organizations, on a massive scale, comprehensive systems of information tokens and codes that sustain software packages, and also generating an immense output of data and information tokens.

His study focuses on the milk refinement process at the heart of dairy production. Seven treatment lines produce over 50 products. Production is steered from a separate room that forms the production control center of the plant. Planning, controlling and monitoring are highly computerized, with process operators following the status and progression of production on panels of bulbs and monitors in the control center. Several printouts also report incidents in the production process. The software package provides the means for controlling the quantity of received milk, channeling it into milk silos where it is preserved at the appropriate temperature before being refined.. The complex process of production is steered with the aid of three computers with human intervention at points to make commands and check progress.

Compared to other semi-automated production plants, high computerization changed the nature of work and personal-social-technological interactions. For example, in order to grasp how the software package worked and what it signified, it was necessary to reconstruct mentally the physical processes and flows regulated by the package. The cognitive burden and reliance on not easy-to-understand symbols and text were greatly increased through use of the software, computers and related displays, while physical presence in the production process, and information there from, were greatly decreased, not least due to the operators' location in the remote control room. We see here fundamental changes in the way the personal, social and material interact through sociation, embodiment, sociomateriality and semiosis. Signification becomes increasingly abstract and representational. Thus sixteen panels with 700 color coded bulbs report the progression and status of the process. A process printout records failures and their location though in a highly coded form. A highly coded

system printout, often requiring specialized staff for its interpretation, records disturbances to the adequacy of the conceptual and organizational logic of the software package itself, and brings another series of codes, categories and definitions. In fact the documentation of the software package and the installations to which it relates involves 50 manuals of symbols definitions, codes and relationships and functions. Lack of physical experience with the installations, and lack of knowledge of the tangible reality of the plant were seen as severe limitations on operator capability, while at the same time the increased reliance on abstract coding systems increased their stress and anxiety.

Kallinikos records that some moves towards improving referential attribution were made in the sign systems utilized. For example, the bulb system was geometrically organized to recapture the totality of the production process, through the decomposition and elaborate segmentation of its various steps. A sort of structural resemblance was thus established between the bulbs (symbol tokens) and the absent reality of the refinement process (reference). The geometric arrangement of the signaling system also contained an indication of temporal patterns. In a relatively simple, and precise way, the process printouts came to complement the bulbs system by indicating through numerical description the installation item concerned and through binary coding (right-wrong, stop-go) its current state. However, operators seemed to suggest that the vicarious representations of the software “failed to restore the confidence that referential reality is capable of providing to people accustomed to context-embedded work based not just on the reasoning and distancing capacity of the eye, but on sensory-motor manipulation of tangible things” (Kallinikos, 2011, p. 116). His study is particularly rich in showing the central role semiosis needs to play in the study of ICTs in work organizations. ICTs interacting with people and organization in this case, saw process operators seemingly needing to turn their back on the physical production process and devote themselves instead to the task of examining the very structure of signs, codes and symbol schemes, whereby physical relationships were mediated and regulated. The codifications of the software package did not represent a mirror image of the material and technological constitution of the work processes, but produced a multi-layered fragmented systems of signs and codes that saw little relationship between token and referent, but influenced and was influenced by interaction through sociation, sociomateriality and embodiment as represented in our framework.

9. Discussion

We have used case research in HCI, virtual worlds, social media and computerized production plants to illustrate the applicability of the integrative semiotics framework arrived at in this paper. This, of course, does not exhaust the possibilities for the framework, especially in an IS field replete with technologies of information and communication highly dependent on codes and signification processes. Our own view of the three worlds framework in Figure 3 is that there are different degrees of relationship between them in different contexts. Thus social networking/communication would seem to be heavily technologically dependent, with each new technological generation bringing forth new possibilities, while religion, for example, is heavily based on social practices and symbolism, and little on technology. The three systems interact generating emergent and enactive phenomena within any particular context, and, following our critical realist underpinning, these emergent phenomena can themselves affect the underlying systems in a process of downward causation.

Our summary integrative framework and illustrative examples place us in a position to assess, and differentiate our position from, several strands of sociomateriality. We would first critique Orlikowski's later work, where the relationship between the social and the material (primarily technology) is quite radical. We neither have one dominating the other; nor two independent but interacting domains; but rather the two are so inextricably interrelated that they cannot be separated, and their properties are defined only in relation to each other.

“In other words, entities (whether humans or technologies) have no inherent properties, but acquire form, attributes, and capabilities through their interpenetration. This is a relational ontology that presumes the social and the material are inherently inseparable.” (W.

Orlikowski & Scott, 2008, p. 455).

Interestingly, this quote would actually seem to be inherently self-contradictory since if we take it to be true then it would not be possible to parenthesize “humans or technologies” since the two would be indistinguishable. In terms of the framework articulated in this paper, we would argue that sociomateriality as described in Orlikowski and Scott (2008) actually involves a triple reduction. Let us look at these in more detail.

Firstly, it reduces what should properly be two distinct but interacting structures to a duality that loses sight of both of its components. One reason for this reduction is the lack of what Elder-Vass (2008a) calls a depth ontology, and this would seem to be an inherited influence from Giddens' structuration theory⁹, but also from actor network theory (ANT) (Elder-Vass, 2008b). The distinctions between the empirical, the actual, and the real provide a dimension of *depth* to critical realism's ontology. Bhaskar's ontology, as we use it, has a second dimension of depth in its recognition that reality is stratified into an ontological hierarchy of entities, in which higher level entities have emergent properties – properties not possessed by the lower level entities that are their parts. These mechanisms in the domain of the real are responsible for emergent properties, synonymous with causal powers, that interact to produce actual events. For critical realists both social structures and human individuals are entities with emergent properties that arise from their ontological structure. Thus a critical realist account of the social, material and personal can recognize that human individuals, social structures and indeed entities of other kinds have causal powers that are distinct from each other, and that both (or all) interact to determine events - for example social events though human individuals are parts of the social structure concerned. By contrast, Orlikowski and Scott (2008) subscribe to a relational ontology that presumes the social and the material are inherently inseparable, an ontological fusion signaled by the lack of a hyphen in 'sociomaterial'. They also see ANT, sympathetically, as the most prominent part of the sociomateriality literature. But as Elder-Vass (Elder-Vass, 2008b) points out, ANT's ontology has a multi-dimensional absence of depth ontology and tends to be limited to the empirical. Its ontological flatness, and its assumption of symmetry between human and non-human actors, mean that it cannot subscribe to critical realism's assumption that particular causal powers (and hence the particular terminology appropriate to their description) vary depending on the underlying structure and mechanisms of each type of actor, be it material, social or personal.

Secondly, it reduces the role of active subjects without whom neither society nor technology would actually exist or be reproduced; semiosis itself only operates through individual

⁹ Writing from a critical realist perspective on integrating institutional, relational, embodied and emergent attributes of structure, Elder-Vass (2008a) rejects structuration theory's conflationist ontology while seeing some value in Giddens' theory of the embodied facet of social structure.

subjects who must always be the ultimate efficient cause of any interaction. As critical realism argues, social structures (and technological structures to the extent that they are part of a social system as characterized in socio-technical systems and actor network theories) do not exist independently of the activities and practices that they regulate, and only exist in their effects or occurrences. Moreover, social structures do not exist independently of peoples' understanding of what they are doing. Thus the social and the material cannot have a direct interaction, or indeed entanglement, without the mediation of people and semiosis. In the way sociomateriality is portrayed and operationalized in, for example, Orlikowski (2010) and Scott and Orlikowski (2009) people and semiosis are operational but, we would argue, insufficiently theoretically accounted for.

Thirdly, it reduces the role of semiosis as the process and mechanism through which meaningful human activity occurs. Social relationships and structures are all embedded and represented in a semiotic fashion and physical media both represent and transmit signs and symbols but also only become objects of representation and interaction to the extent that they are or can be represented symbolically. In other words, technology/media are both a medium of semiosis, but also both a condition for and result of semiosis.

Interestingly, the position represented in Figure 3 is in fact quite compatible with Orlikowski (2000) which puts forward the idea of a technology-in-practice view, though we have of course provided the addition of semiotics. We also preserve the idea inherent in a critical realist position but not in that of Orlikowski (2000) that, notwithstanding the second point above, social structure is ontologically separate from the activities of individual people. It both pre-dates any particular individual, and can in time be reproduced or transformed by their activities (Archer, 1995, 2000).

10. Conclusion

In this paper we establish that semiosis, and thus semiotics, is at the heart of the representation and transmission of information and meaning, and thus central to processes of communication and information systems. By establishing philosophical foundations in a Peircean semiotics rendered consistent with critical realism, we were able to build in theories

of information, meaning and embodiment to construct a consistent, integrative framework of operationalizable concepts for studying information systems and the personal, social and material worlds they inhabit. Recent advances in ICTs and their effects, as highlighted in our illustrative case studies on avatars, social media and synthetic/virtual worlds, bring a new urgency into information systems studies to develop a philosophical foundation and conceptual and analytical tools for researching the full meaning of material and non-material objects and their interaction. In this we are merely pointing to the escalation of what Zuboff (1988) alluded to some time ago in her claim that ICTs were altering the tangible, social and personal nature of work and experience, transforming them, literally to reading, that is, “an encounter with symbol schemes and data items that are supposed to represent surrogate versions of physical and social items and relationships” (Kallinikos, 2011, p. 92).

In conditions of accelerating virtualization, abstractness and representation driven by advances in technologies, media and software, this paper has aimed to provide a more philosophically grounded, more comprehensive theoretical framework for use in carrying out IS research. The framework throws light on recent conceptualizations of the relationship between the social and the technological such as sociomateriality, not least the notion that sociomateriality is always being enacted, performed and in the making. But on our view, two other relationships - of sociation and embodiment - also need to be addressed on a more precise basis, and semiosis needs to play a central, explicit rather than implied, part in the study of contemporary ICTs.

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