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Revisiting hylomorphism: What can it contribute to our understanding of information systems?

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Full Paper

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Abstract

Theorising about digital technology is core to the IS discipline. This paper presents an interpretation of technology using hylomorphism, the theory that material objects comprise both matter and form. A contemporary understanding of hylomorphism argues that the form of an object is dynamic structure, which may be actualised in the process of interacting with other objects. This paper arose out of a critical realist study on the use of technology in the classroom by senior secondary students in New Zealand. The role of theory in critical realism is outlined, and then the findings that stimulated this paper are presented. A brief history of hylomorphism is discussed before moving to the contemporary revival of Aristotelian theories. Some implications of this theory on IS research are presented, including an outline of emergence and methodological considerations.

Keywords Hylomorphism, critical realism, Aristotle, form, matter, emergence

1 INTRODUCTION

It has been 18 years since Orlikowski and Iacono (2001, p. 121) observed that "… the field of information systems (IS), which is premised on the centrality of information technology in everyday life, has not deeply engaged with its core subject matter – the information technology (IT) artifact". While there have been calls for pragmatic and practical analysis of the specific over the general (Alter 2015), it has been argued that inadequate theorising of the IT artifact has led to difficulty in developing deeper, sustainable theories around the IS constructs, and thus distinguishing our research space (Grover and Lyytinen 2015, p. 283). Recent work shows that there is still interest in the "… difficult ontological questions that arise about [digital objects'] structure, mode of being, and other basic properties" (Faulkner and Runde 2019, p. 2).

2 CRITICAL REALISM AND THEORY

This short paper presents a reflection on technology that arose through a critical realist study that explored information technology (IT) in the everyday life of secondary school students in New Zealand.

The philosophical basis and methodological considerations of critical realism generally (Bhaskar 1975, 1993, 2005) and in relation to information systems (Williams and Wynn 2018; Wynn and Williams 2012) are well discussed in the literature. At the core of Bhaskar's critical realism lies the question, "what does science as a social practice tell us what the world must be like" (Bhaskar 1975, p. xv). A primary objective of research in critical realism is to "develop explanations for the way things act and how they are capable of doing so" (Wynn and Williams 2012, p. 795), rather than aiming to make predictions, or understanding the social or cultural meaning of an event.

The role of theory in critical realism is also different from other paradigms. In Humean empiricism theories present hypotheses of relations between observable events, and the validity of the theory is assessed against the data; theories are highly general, express regular relationships that are found to exist in the world, and contribute predictive and explanatory knowledge of the world. In Kantian idealism theories are constructions of imagined relations between phenomena, which cannot be true or false, but can be more or less useful.

In critical realism research theory and data are intrinsically related because, from the foundational pillar of ontological realism, while reality is independent of our knowledge of theory and concepts, we cannot understand reality without using our knowledge. From epistemological relativism, our knowledge of reality is contingent, but is not simple or arbitrary; it is fallible, but not equally fallible. The goal of any investigation is a descriptive or explanatory account which provides a plausible model based on judgmental rationality between competing theories. In an open system an event may not be replicable, existing theories may not reflect reality accurately, and some theories may be more correct than others. Our theories and concepts are constantly being developed, and they are developed in relation to the events we experience when we use them to understand reality.

Theories are useful frameworks of interpretation in the abductive and retroductive phases of the critical realist methodological model of explanation (Wynn and Williams 2012). Theory "…privileges seeing, and thus one function of theory is to help individuals see and interpret phenomena and events…. Social theories are thus heuristic devices to interpret and make sense of social life." (Kellner 1995, pp. 24–5). A critical realist researcher may tend to spend a great deal of time considering how philosophical and social theories can illuminate the data, in order to gain insight into the generative mechanism which "if it were to exist and act in the postulated way would account for the phenomenon in question" (Bhaskar 1975, p. 12). Philosophical theories can illuminate intentionality and the conditions of human activity. Social theories can reconstruct social structures such as power, social positions and social conventions.

The study examined how senior secondary students used technology in the New Zealand classroom. Four secondary schools in medium- to high-income areas of New Zealand participated in this qualitative study. In the 11 classes that participated, each under two to four weeks of observation, almost every student had access to digital devices, and almost every student used digital devices in their learning. This paper focuses on two of the key findings from the data. It was observed that each student had slightly different technology, and each student was working with slightly different information. It was acknowledged that students who are in the same class and who are doing the same thing can have very different learning experiences (Nuthall 2007). The findings are:

- If students had to complete action P, eg, an analysis using one of the statistical software programmes available, they could use any of multiple combinations of hardware (A, D or J) and

software (B, E or K) and information (C, F or L); this can be written as ABC or DEF or JKL → P; and

- With a combination of hardware (A) and software (B) and information (C) the students could achieve a plurality of effects, as they could both write their essay (P - a cognitive action) and share it with their teachers (Q - an instrumental action); this can be written as ABC → P and / or Q.

In an open system critical realism accepts that at all stages of explanation there are a *multiplicity of causes* and a *plurality of effects*, and key to explanation is using theory to understand the data. The data appeared to suggest that learning with technology could be effectively black boxed – given an educational task the student could select from a range of hardware, software and information and produce an acceptable result. The technologies were not fixed and were easily substituted, so a material lens to examine the technology became less salient. A functional lens was also insufficient to account for these findings, as a student could, with exactly the same technology and information, be performing a plurality of functions.

To find a causal mechanism that could account for both a multiplicity of causes and a plurality of effects, Aristotle's hylomorphism was considered. Hylomorphism presents the view that material objects are comprised of both matter and form. Using a modern version of *form as dynamic structure* provided a rational explanation for the findings, and the students' experiences with technology.

3 AN ACCOUNT OF OBJECTS

3.1 A brief introduction to hylomorphism

Hylomorphism is a theory attributed to Aristotle that material objects comprise both matter and form. During the medieval period hylomorphism was the dominant view of material objects, but with the rise of science in the early modern period this view was rejected in favour of empirically adequate, scientifically-informed, reductionist accounts. Hylomorphism was seen as hopelessly outdated (Skrzypek 2016).

Recently there has been a revival of interest in Aristotelian theories, including hylomorphism, in contemporary metaphysics. An early proponent of structural hylomorphism is Koslicki who wrote (2008, pp. 172–4):

> I propose that we once more follow Plato and Aristotle in assuming that the world is best described by taking ordinary material objects to … consist of the two components of structure or form, on the one hand, and content or matter, on the other.

Koslicki equated form with *structure*, and the next section will discuss structural hylomorphism and dynamic structural hylomorphism.

3.2 Form as structure and dynamic structure

There is a common, but incorrect, assumption that form is equivalent to shape: that a table is a table because it is shaped like a table (Harman 2011, p. 36). Nor is form equivalent to its category of objects (a table is a table because it can be grouped with tables), its essential properties (a table is a table because it is table-like), or its physical relations between material parts (a table has four legs) (Roudaut 2018).

The first step in modern hylomorphism is that form can be identified as the *structure* of an object. A common example of a material object is a water molecule. That molecule consists of three components: one oxygen atom and two hydrogen atoms. Yet these components must be arranged in a certain way in order for them to compose the water molecule. Atoms that exist millions of kilometres apart do not compose a water molecule. It is at least necessary that these atoms be structured in some definite way.

A less common example is a melody. In order for notes to compose a melody they must be structured in a specific way: one specific note of a defined duration is followed other notes. If the same notes are played in a different order it is not the melody. Thus, a melody is also a structured entity (Paolini Paoletti 2018).

Structure is a basic *ontological* principle: it concerns what things *are*. It is also a basic *explanatory* principle: it concerns what things can *do* (Jaworski 2016). Most assumptions of form are static conceptualisations, but this understanding conceptualises form as dynamic structure. An example is a fountain: "the configuration of a fountain… is intrinsically unstable, and it can retain its shape only by endlessly renewing the material which constitutes it; that is, by organising and imposing structure on

the unremitting flow of its own substance…" (Miller (1978) in Jaworski 2016, p. 43). Structures are not merely static spatial relations, they are instead dynamic patterns of environmental interaction. This also means that an object has the ability to *impose its structures* on incoming matter and energy in its interactions with the wider world (Jaworski 2016; Roudaut 2018).

There are limits as to when structure can be actualised. The ability that an object has to *impose its structure* on another object is only manifested in specific circumstances, and only if the second object has the power to be affected. When the objects are conjoined in the right circumstances then the powers to structure and to be structured may be actualised. Using examples of water: water can only exercise its *power to structure* to dissolve things in conjunction with things that have the power to be dissolved in water; a fountain can only exercise its power to structure things like water that have the *power to be structured* in a fountain. These examples show that even something as simple as water has multiple structural powers; these may not be known before they are actualised, and not all of these powers will be actualised, let alone at the same time.

A modern definition of form is (Roudaut 2018, p. 14),

> Form refers to the internal principle of coherence in things, accounting for their unity, but also for their identity through time (an object A is identical with an object B if and only if they share the same numerical form). The distinction between integral and metaphysical parts allows the object to change according to its material parts without having its identity altered.

Thus form persists, even when the materiality changes.

Structure manifests differently in conjunction with different objects. Bowling and pétanque are both played with balls, but a bowling ball will roll on a hard surface while a boule will sink in soft sand. The surfaces and the balls have form and matter, structure and content, and together they cause the outcome. However, while the surfaces and the balls interact, they do not form a complex entity. Whether a relationship between objects results in a complex, structured, emergent object will be discussed in the section on emergence.

4 APPLICATION TO IS RESEARCH

This paper does not position form as a stand-alone and complete explanation. Its aim is to open up debate, while staying mindful to patterns of difference and possibilities (Scott and Orlikowski 2013). In hylomorphism ordinary material objects consist of form *and* matter. Consideration of form is only one way to understand the causality of process-in-product that constitutes the emergent whole, and it is not complete on its own.

This understanding reconceptualises objects as having dynamic force. The dynamic force of objects, like affordances, can be both positive and negative. A person can express their agency through actions, but the technology can shape those actions: it can enable, resist or deflect actions. This is not through the agency of the technology, but because the technology, as an object, has the causal power to structure and regulate actions.

While this is not an orthodox position in information systems there are perspectives that come to a similar result through different means. Markus and Silver's (2008) spirit of technology through adaptive structuration theory, Markus and Silver's (2013) functional affordances, and Pentland and Feldman's (2008) grammar through actor network theory all posit a dynamic force in the technology. Outside information systems affordances (Gibson 2014) and object oriented ontology (Harman 2018) recognise structuring forces in objects (and non-objects). In critical realism causation is not a property of things but of the continuing activity of things; the reality of a thing is ascribed by its causal criterion, its ability *to do* (Bhaskar 1975, 2005). This paper notes that explanation types are limited in the scope of what is actually explained, but argues that considering different types of explanation can provide complementary and holistic understanding of complex information systems phenomena (Hovorka et al. 2008).

4.1 Emergence

Hylomorphism is able to contribute explanation at the level of simple, external relations between objects, as well as at the level of complex emergent entities, in which case an understanding of emergence is entailed. This is particularly relevant given the argument that an information systems artifact is an *emergent entity* comprising a technology artifact, an information artifact and a social artifact (Lee et al. 2015).

In critical realism emergence is a process that entails both stratification and change, and has its own dynamism (Bhaskar 1993, 2005). An object is a *structured, emergent object* if (Lawson 2012):

- it arises out of the relational organising of lower level components; and
- it is dependent on the lower level for its existence; but
- it has causal powers of its own, and these are irreducible to those operating on the lower level.

In open social systems there are multiple recursive, social, and semiotic processes, and emergence is the outcome of multiple and changing mechanisms, agencies and circumstances. The information systems artifact is an emergent, structured, supervenient, processual totality, and form is essential to this process. This organisation is always a novel phenomenon, given the multiplicity of causes and the plurality of effects. The process is not teleologically driven; it is formed from the interaction of the component parts.

Once the structured object comes into existence it is essentially and continuously engaged in configuring materials, which are precisely those components that compose it. The structures may be decentred, asymmetrical, and even have internal contradiction. They will be subject to the entropy of the real world, they will emerge and disemerge; the higher-order level will decay, demise or disjoint.

The information system, then, is conjuncturally determined. The extent of the explanation between the components and in reference to the totality is not pre-determined, and may always be changing. This conceptualisation of emergence evokes a roiling, tumultuous, almost inexorable event, but in the classrooms of the study these were quiet, easy events that happened tens, even hundreds of times in every lesson every day.

4.2 Form and matter

This understanding of form overcomes an issue associated with sociomateriality, that if the social and the technological are entangled, then how does the information systems field distinguish itself from organizational or management research (Sarker et al. 2013, p. 14)? The strong ontological stance of critical realism refuses to conflate subjects, objects and relations (Al-Amoudi et al. 2017), and hylomorphism requires ontological distinction between the technology artifact and the social artifact. This distinction does not require separation into discrete tangible units, nor an autonomy that precludes co-constitution and intra-connection (Gunnarsson 2015). Similarly, if the technology artifact is merely an instrumental tool then there is no mutual interaction (as in a socio-technical lens), and use is a reductionist, unidirectional action. This paper argues that the technological artefact is neither instrumental nor entangled with the social, it is an object in its own right that has structural, dynamic form.

Further, this understanding of form does not only apply to the technological artefact: information is also an ontological object, and also has form and matter. With a dynamic understanding of structural form the relationship between the technology artefact and the information artefact can be examined without resorting to entanglement with the social. Given that most of the photographs now being taken are to be viewed by machines for machine learning and facial recognition purposes and not by humans, how the technology interacts with the information is increasingly salient.

4.3 Methodological implications

An explanation based on matter focuses on actual (not potential) causes which can be determined a priori, and can be used to present normative knowledge claims about how the student should be using the technology to take full advantage of its material properties. This provides a single position towards which we should direct our actions. An explanation based on form focuses on its potential, its telenomic push, which is observed a posteriori through research. It focuses on what the technology actually does, and how its interaction with the social and the information can explain the phenomenon. While this is part of the methodological method of explanation of critical realism, it may also be part of the *push to the edge*, to develop bold theorising about information, IT and the social domain, and the relations between them (Grover and Lyytinen 2015; Williams and Wynn 2018). This is the starting position from which the possibilities of action arise, and from where we can ask how can information systems improve our lives.

5 CONCLUSION

This paper offers a concept of the IT artifact that is unorthodox in information systems, but technology is now a part of our lives in ways which were unorthodox merely ten years ago. In our world we no longer

know when or how technology is structuring our lives: what surveillance system is structuring how we travel through an airport or a smart city, how are our Facebook feeds or Google searches structuring our understanding of the world. Observing the students interact with technology in the classroom presented a microcosm of how the students interact with technology, and how technology interacts with students. While the students selected technology, used it in multiple ways for a plurality of outcomes, and then set it aside, the technology also structured the actions that the students could perform. This conceptualisation of form as dynamic structure is a lens to explore the interaction between the social, the technological, and information.

This revindication of form (with emergence) is proposed as an alternative to reductive materialism with deflationary accounts of objects and persons where things are a collection of parts, or sociomaterial accounts where there is no difference between the social and the technical. It is an alternative where form structures matter, and can account for capacities and powers.

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