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The Givenness of the Human Learning Experience and its Incompatibility with Information Analytics

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Abstract:

The rise of Learning Analytics, the application of complex metrics developed to exploit the proliferation of 'Big Data' in educational work, raises important moral questions about the nature of what is measurable in education. Teachers, schools and nations are increasingly held to account based on metrics, exacerbating the tendency for fine-grained measurement of learning experiences. In this article, the origins of Learning Analytics' ontology are explored, drawing upon core ideas in the philosophy of computing, such as the general definition of information and the information-theoretic account of knowledge.

Drawing upon a reading of Descartes Meditatio II, *which extends the phenomenology of Jean-Luc Marion into a pedagogy of intentionality, the article identifies a fundamental incompatibility between the subjective experience of learning and the information-theoretic account of knowledge. Human subjects experience and value their own information incommensurably with the ways in which computers measure and quantify information. The consequences of this finding for the design of online learning environments, and the necessary limitations of Learning Analytics and measurement are explored.*

Keywords: learning analytics, René Descartes, Jean-Luc Marion, philosophy of information

Introduction

The impact of learning analytics on contemporary education is pervasive, and has largely advanced without investigation of its informational ontology. Learning analytics denotes 'the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environment in which it occurs' (Siemens, et al., 2011), but such a definition begs the question of what constitutes optimal learning. The range of datasets used by learning analytics software to measure and optimise student learning includes highlighted text (SparTagUs), comprehension questions (Zementis-ADAPA) and visual models (Cognos), while approaches still in development measure at an even more minute level, using keystroke patterns and eye tracking to develop an increasingly granular model of the learning subject. Technologies currently under development effect a neurological reduction, promising real-time brain scanning in the classroom. While some of these applications may seem far into the future, there are few educators or educational administrators who are not familiar with a range of software packages promising predictivity based on baseline and continuing assessments. The availability of these fine-grained measures, and their increasing importance has heralded fundamental shifts in the meaning of learning (Lundie, 2014a) which remain largely unexamined. Given the unforeseen impact which systems of assessment can have on learning (Nichol, 2012), and the bias which unreflective information systems design can introduce into their use (Friedman & Nissenbaum, 1996), an exploration of the epistemic assumptions underpinning learning analytics is both timely and pertinent.

I will argue that much of the present design processes and theories of learning analytics, by emphasising the mediation of learning, rather than the interaction which constitutes

education, absent an important pedagogical dimension. The concepts of information and learning derived from information systems design are at best metaphors for human education, and fail to capture an important aspect of the *givenness* of human subjective experience. This *givenness* is explored here through a consideration of the Cartesian self.

The growth of learning analytics parallels that of the rise of 'Big Data', the proliferation of fine-grained metrics about all aspects of human life, gathered by an increasingly networked ambient environment. By some measures, more data is generated every 2 days than in the whole of human history up until 2003 (Siegler, 2010). Growing concerns over the growth and sharing of such multifaceted metrics, including the corporate acquisition of government data and government appropriation of corporate data by government have led to calls for a digital charter to protect openness and individual freedom online (Lundie, 2014b).

For liberal conceptions of education, this granularity of measurement and control raises fundamental questions. As legal scholar Julie Cohen observes:

> Autonomous individuals do not spring full-blown from the womb. We must learn to process information and to draw our own conclusions about the world around us… 'Autonomy' constitutes an essential independence of critical faculty and an imperviousness to influence. But to the extent that information shapes behavior, autonomy is radically contingent upon environment and circumstance. The only tenable solution – if autonomy is not to degenerate into the simple stimulus-response behavior sought by direct marketers – is to underdetermine environment (Cohen, 2000, p. 1400).

Besides the substantial moral questions raised by the prospect of increasing invasion into the learner's private thoughts (Van den Hoven, 1997; Wolpe, Foster, & Langleben, 2005), many learning analytics applications rely on an attenuated conception of learning, which has the potential to elide the most fundamentally human elements of education, at precisely the moment when human distinctiveness is most profoundly threatened by 'intelligent' systems of control control (Floridi, 2005; Spencer, 1996). This article explores the epistemic foundations of information theory, central to the design of many 'intelligent' systems in the world of Big Data which includes learning analytics, and contrasts this with a phenomenology of human learning foundational to the European Enlightenment tradition from Descartes onwards, to illustrate a fundamental incompatibility.

In an insightful sociological analysis of the impact of digital analytics on education, Selwyn (2014) identifies six areas for further study in the ethical consideration of learning analytics:

1) What data exist in educational contexts? – including concern for the inter-operability and compatibility of data.
2) What are the 'primary' uses of these data? – in the case of learning analytics, the stated uses relate to optimisation, evaluative and formative assessment
3) What, if any, are the 'secondary' uses of these data? – relating to concerns of contextual integrity – data being shared and re-used in unintended contexts (Solove, 1997)

4) What are the consequences of these uses of data? – relating to questions of informational injustice – accumulation of data being used to create a power differential between users and analysts (Van den Hoven, 1997)

5) What organisational cultures have formed around the use of data within educational settings, and with what outcomes? – relating to emergent bias – the capacity of social uses of data systems to deflect from their stated purposes (Friedman & Nissenbaum, 1996)

6) How might data work be more efficiently and equitably arranged in educational contexts? – again relating to the varieties of informational injustice. (Selwyn, 2014, pp. 13-14)

While ethical questions regarding the social uses of data have been extensively explored elsewhere, the analysis that follows is aimed at addressing the first and most fundamental of Selwyn's questions, whether the data of human learning are fundamentally compatible and inter-operable with information as conceptualised, gathered and processed in learning analytic systems as currently designed. It is not the intention of this paper to problematize all learning technologies (cf. Steigler 2010), but rather to confine itself to a particular problem set – the reduction of human learning to that which is measurable and compatible with data gathered by analytics software. Whether learning, either as process or outcome, can be rendered inter-operable with the call-response protocols by which machines exchange information is an important and under-theorised question.

The Information-Theoretic Conception

From its beginnings, information technology has engaged with philosophical questions in epistemology and ontology. Initially, the philosophy of information was largely concerned with the authentication of truth values in communication and machine manipulation of data. As such, it remained largely a sub-set of the philosophy of mathematics. Until recently, ethical discussions have been limited to the material effects of information technology, such as designing an air-traffic control system with failsafes to prevent planes falling out of the sky in the event of communication failure. Under such a description, ethical systems are synonymous with efficient systems, and the social effects of their design or use are regarded as 'inherently value neutral' (Alder, 1998). More recently, however, increasing concerns have been raised about ethical issues inherent in information systems and their use (Loch & Conger, 1996), (Wicker & Schrader, 2010), recognising that the way information systems collect and present information can have profound effects on a range of social interactions from our understandings of privacy (Schrader, Yan, Lundie, & Schulze, 2011) to our employment opportunities (Spencer, 1996).

The information-theoretic account of knowledge, which has until recently been the dominant view in the philosophy of information and computing, attempts to address the problem of linking truth, knowledge and justification on the basis of information alone. Formally, this account states:

> K knows that s is F = K's belief that s is F is caused (or causally sustained) by the information that s is F (Dretske, 1981)

This approach seeks to solve Gettier-type problems of justification which undermine positivist epistemology (Gettier, 1963) by positing only causal chains. All justifications are simply further information about information. This account requires a definition of information such that information is meaningful, well-formed data (Floridi, 2004). Such an account is highly satisfactory when designing systems for information transfer and authentication, and consequently occupies a prominent place in information technology. To define such transfer and authentication as constitutive of human learning, however, is potentially penurious, not least because the definition of information on which it rests: 'x is information that p if [and only if] p' (Dretske, 1981) requires recourse to some other, referentially grounded, epistemic consideration if the information world is not to float free of any referent in the 'real' world.

This mechanistic approach to knowledge is nothing new, in 1749, La Mettrie articulates an epstemology in many ways similar to the information-theoretic account of knowledge:

> 'sounds or words, which are transmitted from one person's mouth, through another's ear and into his brain' (La Mettrie, 1996, p. 13).

All sensory justifications, on this account, are information transmission. While Dretske does go on to nuance this theory, for instance by differentiating between 'structuring' causes which consist of information at the programming level and 'triggering' causes, when information acts upon that program (Dretske 1991, 114), considering this to establish an explanatory connection between thought and action, and recognising that information does not equal meaning, he asserts that to explain 'why a system… behaves the way it does, we are often asking a question that requires going outside the system for the answer' (Dretske 1993, 209). Approaches to intelligence in information theory tend either towards an informational-causal monism or to posit the impossibility of the question, due to the necessity of 'going outside' the system in order to answer the question of meaning. In drawing attention to a phenomenological model which recognises human conscious experience as neither caused nor dualistic or exterior to the material, I wish to challenge the inference inherent in the natural-language-use test for artificial intelligence. According to this test, a machine is intelligent if it is capable of using language in a way indistinguishable from an intelligent being (Turing 1949). On such an account, there is no 'inside' to intelligence, no intelligent being, but merely an intelligence in the abstract, defined by its role in the causal chain. This causal reductivism has potentially penurious consequences for education.

Contemporary attempts to situate machine learning in terms of symbol-grounding, enabling machines to associate information with referents in the world, still rely on this informational reduction of all data, and an equivalence between sense perception and information transmission, adding to it a further equivalence between subjective knowledge and sensory information. The symbol-grounding approach attempts to simulate in intelligent machinery a view of the brain which functions:

by internalizing the process of creating m[eaningful]-representations. Rather than producing the representation in terms of external physical symbols (sounds, gestures…) an internal image is created and re-entered and processed as if it was perceived externally. (Steels, 2008)

According to this view, the brain's internal 'imaging' can be understood as representational, in the same way as external sensory data. As such, the brain can be understood as an information processor, receiving information from its internal processing (memories, imagination) in the same way as other information channels. I will argue that this model is insufficient for the development of human learning because the causal account on which it rests is neither necessary nor sufficient to account for the phenomenon of human subjectivity, an essential prerequisite for learning.

In the absence of any non-informational justification, the information-theoretic conception of knowledge relies upon mathematical probability for epistemic certainty. The mathematical theory of communication proposes that information justifies knowledge in inverse proportion to probability (Shannon & Weaver, 1949). I have left my car door locked or unlocked, p='my car is unlocked' has two possible states, so one piece of information can determine the truth value of p. If I know that one car in the car park has been left unlocked, however, many more items of information may be required to determine p's truth value. Under this description, the more items of granular information can be gathered, the more certain an analytic system can be that learning outcomes have been met.

Furthermore, the General Definition of Information states that each item of information in this causal chain will be formed of *meaningful, well-formed* data (Floridi, 2004). This requires that the data can be understood, exchanged and interpreted in similar ways by more than one information processor.

I contend that this account of knowledge, while highly satisfactory for the design of information systems, is entirely unsuited to the nature of education, because the epistemic value of learning is grounded in the learner as subject, not the data of learning content. As such, optimisation cannot be understood solely as a function of effective transmission of information through causal chains. Furthermore, the nature of human learning is grounded in a givenness which is irreducible to information transfer and incompatible with the general definition of information. Given that the success of information systems in use depends on the effective interaction between agents and mediating technologies (Ess, 2009), if the nature of one set of agents - the human learners - is fundamentally misunderstood in design, this can lead to bias in system use, with unforeseen social consequences (Friedman & Nissenbaum, 1996). In the case of Learning Analytics, the unforeseen consequences can be seen in the elision of value and intent from learning, and a focus on information transfer which reduces and trivialises learner autonomy. Furthermore, by relying on granular metrics to test the human learner's ability to complete a narrow set of tasks, involving the transfer and authentication of information (content knowledge and assessment), the stage is set for a form of education in which human learners are systemically subordinated to more efficient artificial information processors.

The Learner as Intentional Subject

Some advocates of informational accounts of knowledge have drawn upon Cartesian conceptions of the logical self as disembodied agent, separate from the world of objects about which information can be gathered, to ground an ontology of the human subject onto which information can be projected and processed (Bailey, 2005). This understanding of the knowing agent misrepresents or elides an essential element of the Cartesian project. As Jean-Luc Marion (2003) has argued, the Cartesian ego is not solipsistic nor self-affirming but exists through 'the originary interlocution of another who posits the *ego* in existence' (p.49). In *Meditatio II*, Descartes posits:

> Nunquid est aliquis Deus, vel quocunque nomine illum vocem, qui mihi has ipsas cogitationes immitttit? [Is there not a God, or whatever he may be called, who gives me in myself the thoughts I am now having?] (Descartes, 2008)

From this, Marion infers the necessity of alterity to the Cartesian ego. Whether the ego is being persuaded or deceived, the structure of a dialogue posits a self. The ego's self-awareness on this account is not caused by a chain of information, which presupposes an information processor capable of giving meaning to the information. Instead, the ego encounters its *ipseity*, its selfhood, as given. This givenness enables the subject to know their existence but not to infer from this their essence. I may know that I am, but not know what it is that I am (Marion, 2003). Givenness is not equivalent to the 'ego cogito', the thought thinking about itself – '[t]hinking about [the thought] is one mode of givenness; it is another one altogether to find oneself in the presence of – what gives itself.' (Marion, 2002, p. 29). In contrast to the informational-causal reduction on which much Learning Analytics research rests, this conception of the self, which presupposes a being, and a being-in-relation, in order to posit an intelligence, is essential to the pedagogical traditions which constitute both the liberal (cf. Morgan & Guilherme, 2010) and progressive (cf. Biesta, 2012) traditions in Western educational thought.

Marion's reading alludes to the Augustinian origins of the Cartesian project. In the Augustinian *anima*, the interior sense is distinguished from the causal chains of information which reach the subject from the senses or through interpersonal communication,

> of all which sensible objects it is the images resembling them [data], but not themselves, that we perceive in the mind and hold in the memory… However, without any delusive representation of images or phantasms, I am most certain that I am, that I know, and that I delight in this… for if I am deceived, I am. For he who does not exist cannot be deceived… For, as I know that I am, so I know this also, that I know. And when I love these two [being and knowing], I add to them a third, that is, my love, which is of equal importance. (Augustine, City of God, XI, 26, 2007)

This tripartite structure of knowledge, being and love, in which Augustinian pedagogy finds an interior image of God 'for He who is said to reside in the interior man is Christ'

(Augustine, De Magistro XI, 38, 1938) finds its parallel in the role of imagination as constitutive of the intentional ego-subject in Descartes' *Meditatio II*. In this regard, Marion's reading attempts to reintegrate ethics and epistemology (Marion, 2003) around the intentional. The good teacher is not only causally efficient, as the mechanical teacher may be, but is one who draws attention to the intentionality of being.

The canonical reading of Descartes is bound up with a separation between mind and world, subject and object. It is for this reason that information philosopher Luciano Floridi considers the Augustinian position toward the world to be dualistic (Floridi, 2008) and considers it fundamentally 'ontocentric', respectful of the natural order of the universe, 'a naturalistic philosophy that closely resonates with Spinoza, Plato, Confucius, and Buddhist thought (among others) in its affirmation of the intrinsic moral worth of the *cosmos* as such' (p193). Marion's highlighting of the fundamentally relational nature of the Cartesian ego, however, challenges such an account. In the second meditation, Descartes challenges the notion of personal identity as pertaining to the immaterial soul, responsible for such activity as 'me nutriri, incedere, sentire, et cogitare' [nourishment, motion, sense perception and thinking]. Descartes is not introducing here an immateriality to personal being. Rather, he presumes it already on the basis of Christian and classical arguments, but then goes further, to posit a grounding of the ego neither in body nor soul, but in a self-awareness which challenges, and imposes meaning upon, data concerning objects in the world.

Marion (2003) highlights that Descartes is unable to infer essence from existence, yet having established that of all the attributes he ascribes to the soul, only thought establishes existence with certainty, Descartes immediately addresses to himself the question of essence:

> 'Quid praeterea? Imaginabor:' [What else am I? I will use my imagination] (Descartes, 2008, p. 36)

The purpose, then, of the ego, according to this reading is not a solipsistic refutation of the sceptics, but 'Nihil nisi punctum petebat Archimedes, quod esset firmum et immobile, ut integram terram loco dimoveret' (Descartes, 2008); not to separate itself from the world of objects, but to move or order the world. The imagination does precisely this, not by separating subject from object, but by orienting subject-object-telos. The role of imagination in the Cartesian ego bears clear parallels to that of love in the Augustinian soul. Love/imagination as animating principle attach themselves to the certainty of thought, and from it, of being. It is not only that the ego is aware of an informational item, which in the 2nd Meditation assumes an immediacy, no longer *cogito, ergo sum*, but *ego sum, ego existo* (Marion, 2003, p. 41), but this awareness implies agency. Having not previously thought about or known the nature of his being, nor had the author imagined (Descartes, 2008, p. 35) but having come to know, he comes also to imagine.

Only in considering the link between *ego, cogito, imaginatio* in the 2nd Meditation does a Cartesian pedagogy begin to suggest itself. In the analogy of the wax, Descartes sets up a fundamental element of human learning. While a causal chain of information is sufficient to knowing 'ipso sensu externo' the properties of the wax, it is only by 'potentia imaginatrice'

[the power of imagination] that the author's perception, while it may be erroneous, 'non possum tamen sine humana mente percipere' [at least requires a human mind] (Descartes, 2008, p. 44). In drawing upon Augustine's third principle of the certainty of self-knowledge – love, the human mind, the mind of an intentional subject, is required for imaginative learning because only then is a project, a telos, and therefore a meaning, attached to free-floating data about the world. Without meaning, data does not become information.

The argument that an informational causal chain is sufficient to account for knowledge thus fails in an important aspect of human subjectivity. This is so because, contrary to Steels' symbol-grounding conception of the brain, human subjects do not internalise the process of creating meaningful representations, (which is itself to beg the question of a further regress). Rather, the human subject is itself the locus of meaning.

The human mind is required for human learning, not to process knowledge, but to imagine, that is, to direct affection toward the act of coming to know. 'Beyond 'collective representations of the person there is a *unique* particularized singularity… the particular *isness* of the self' (Conroy, 2004, p. 6). This *isness* or intentionality, although enframed and situated in a network of cultural and technological interactions, nonetheless retains an irreducible interior complexity. It is not the alterity of the other which determines this inner realm, as though the data of self-knowledge were marked by meta-data which stated 'inner voice', while the data of interpersonal communication carry 'someone else's voice' meta-data. Rather, the recognition of incompleteness is a constitutive function of individual subjectivity (Conroy, 2009) and the subject is the locus and ground of meaning.

In attempting to account for this grounding of meaning in the subject, Marion describes responsibility in terms of gaze or witness. This is not a causal claim, akin to the downloading of a photograph, because the responsible agent's gaze necessarily entails affect. Augustine's *caritas*, Descartes' *imaginatio* and Marion's *responsibility* posit the immediacy of an irreducible human valuing of the phenomenon of knowing. Information is not necessary for the phenomenon because there is nothing 'behind' the phenomenon from which to form a causal chain, nor is information sufficient for the phenomenon, because data cannot account for this affective dimension to the gaze of the responsible subject. Marion posits three criteria for the givenness of the phenomenon which by definition render it incompatible with an informational account of knowledge:

1) Intrinsic – givenness involves a bracketing out of the giver, there is no recourse to a cause
2) Irrevocable – the given is not reproducible or repeatable [it is in-dividual]
3) Radical – no gap exists between the givenness of a phenomenon and the phenomenon itself (Marion, 2002, pp. 175-176)

The distinction here theorised is pre-ontological, making no claim about the materiality or otherwise of minds. Not only may it be grounded in divergent readings of Heideggerian phenomenology (Marion, 1998) (Zahavi, 1999) but equally in divergent accounts of the Cartesian *cogito*, of which Heidegger was so famously critical. In contrast to the

informational abstraction 'there is thought', as Levinas argues, Descartes' subject may be read as positing the intentional self as 'a thing that thinks' (Wyschogrod, 1990, p. 77). Far from merely 'the carrier of rational knowledge' (Bailey, 2005), the *isness* of this thinking thing has materiality and point of departure. Prior to executing any task the subject as *cogito* in its relationship to materiality, temporality, in short to 'work' enters into a space of immediacy in the sense of not being a producer of inter-operable, mediatable information. It is not by detaching subject from object in service of metaphysical certainty (Bailey, 2005) that the working subject gives meaning to the world, but through the orientation of subject-object-end which constitutes meaningful work. This space is 'the most primordial object of utility' (Wyschogrod, 1990, p. 79) because by it a formative *experience* of the subject in contemplation of activity emerges, and it is from this intentional experience that any subsequent work proceeds. The thinking subject orders the world teleologically, with the thought itself among the objects of this ordering.

In contrast, for informational work, the outcome is always inherent in the programming, such that nothing is gained by its execution (Spencer, 1996), technological production assumes the self as planner, substituting a planned and datafied universe for the universe of givenness (Marion, 2002). In learning which posits the learner as information processor, information passes through the subject, leaving the subject unchanged. Metrics predicated on call-response protocols encourage, or at least do not discourage, this form of work, the authentication-without-remainder of 'correct' informational transactions. It is not that the information present to the senses, mediated through a causal account of knowledge, is delusory as Descartes contended of the *camera obscura* (Descartes, 1954), but rather that information itself does not fulfil the causal relation between learning and acting in the human subject, which requires an act of intentionality.

Reducing givenness to the mathematical theory of communication, in which the quantity of information sufficient for knowledge is inversely proportional to probability, results in a paradox. On the canonical reading of Descartes, only the *ego cogito,* the thought, is required to establish self-knowledge. Given the phenomenon of thought, this single item of information is sufficient to verify p='I exist'. However, as the *ego*, the responsible subject, is itself the ground of meaning, and that meaning is given intrinsically, this datum is not meaningful or well-formed according to the general definition of information. Consequently, this datum is not informational, and it follows that no information is required to verify p. This paradox is resolved with recourse to the intentional reading of *Meditatio II*: the givenness of the phenomenon is immediate, *ego cogito, ego existo*, so there is only one possible state of affairs, and no information is required to verify it. The quantity Q of information required to assert p: the existence of the subject is at once Q=1 and Q=0, because given the phenomenon, the subject must exist. Because the subject remains always insufficient to its own informational truth-value, the subject is always incapable of fully appropriating itself, remaining 'strange from within' (Conroy, 2009, p. 147). The human call-response includes an intersubjectivity not found in computer information transfer protocols, the subject as gift is always other, the *ego* cannot 'authenticate itself without remainder' (Marion, 2002, p. 290).

It is not, then, that self-knowledge and intentionality are immaterial, in the sense of the canonical dualist reading of Descartes, but rather that they are non-informational, being neither compatible with the general definition, nor with a causal chain of knowledge. In contradistinction to the causal chain of authentication proposed by the information-theoretic account of knowledge, Marion draws attention to 'responsibility' as characteristic of the human call-response. Responsibility is not caused but given, a function of:

> 'Mineness' – the characteristic according to which I am at issue, in person and without any possible substitution - … a claim imposes a choice on me; or better; that a claim poses *me* as the *there* where one might recognise oneself…
> In short, the claim does not destroy the irreducible identity-with-self by dismissing any *I* in me, but inversely, underscores and provokes it. (Marion, 1998, p. 201)

Inverting the symbol-grounding approach to interiority as the internalisation of symbols, the intentional or responsible subject requires that processes of symbolic self-representation or authorisation are to some extent metaphorical, any symbol being an imaginary representation of the irreducible self for the purposes of interaction. A causal chain of information is insufficient to account for the self-knowledge of the responsible subject, but it is also, importantly, unnecessary, because responsibility on this account consists in a response not reducible to authentication, and therefore to information.

In place of La Mettrie's *Machine Man,* the account of the human subject set out above: given not caused; responsible not authenticated; intentional not informational, is irreducible to an information-theoretic conception of knowledge. Human subjectivity is not reducible to repeatable, communicable or causally sustained data. Therefore the data of human subjectivity cannot be regarded as meaningful or well-formed according to the general definition of information. <u>Human learners as intentional subjects value their experience of learning incommensurably with information *simpliciter.*</u> In designing human-computer interaction for learning, this metaphorical leap between the irreducible intentional subject and the socio-technically constructed identity of the user must be borne in mind.

Discussion and Conclusion

Without the need to posit an immaterial ego-soul, as the canonical reading of Descartes would suggest, it is nonetheless possible to argue for something constitutive of human subjectivity which is both distinct from call-response chains of information and which manifests that distinction in materially significant ways, not merely as a reflective soul, but as a being acting in and giving meaning to the social and educational world. The intentional subject is the learner as lover of learning, imaginator and witness. Human subjects are distinguished from robots, databases and Turing machines, not by their response to any given problem set (Floridi, 2005) but because they value their own information incommensurably with information in the abstract, viewing it not as exchange value but as gift. My mother's maiden name has an exchange value as a password for my credit cards, but it has another value, linked to memory, heritage and family. This latter value is intentional, it is mine not

because ownership of it was transferred to me in a causal chain, rather its having value for me is inseparable from and coterminous with its being mine.

Learning analytics enables the collection, aggregation and multivariate analysis of large quantities of metadata, information about information transactions, detailed data about how people come to know. This shifts the emphasis of pedagogical research from the interaction of learning subjects to the means by which those interactions are mediated. Metadata is information according to the information-theoretic definition, it is meaningful when used to calculate the probability of a given state of affairs – how likely is it, given the number of words John reads in 60 seconds, that he will be capable of success in English Literature at AS Level. It is not information about the learner as subject – it is unconcerned with consciously willed dispositions or the intentions of the learner. Individuals generate metadata without having any conscious sense of doing so – keystroke patterns, eye tracker movements, even brain states – this data can be aggregated to produce a complex and granular picture with remarkable predictive capacity, yet it entirely ignores conscious human subjectivity. As I hope to have demonstrated, the definitions of knowledge, learning and intelligence derived from the philosophy of computing, as commonly used in definitions of 'machine learning' or 'artificial intelligence', are at best metaphors for simulations of human-like processes. As metaphors, such terms are highly satisfactory in the design of systems. Design aimed at optimizing human learning, however, requires first a recognition that these definitions are insufficient, and secondly an engagement with philosophical pedagogy and the human sciences. Failure to do so can result in a reductive call-response measure of optimal learning as the merest transmission of information. This reductive informationalism represents a clear and present threat to contemporary education.

The responsible human subject must respond '*for* the event as its witness… *to* the affection that his flesh undergoes in and through itself… *for* the scope of his own gaze' (Marion, 2002, p. 293) and not merely to the call in a reductive call-response informational chain. This response *for* learning, and not merely *to* content characterises intentionality, without which learning cannot be witting and willing, or authentically human.

Responding to the question of inter-operability and compatibility, the phenomenon of the human learning subject is not reducible to informational transactions. This conclusion need not be penurious for learning analytics, provided that the metaphorical character of 'learning' as measured by digital data is acknowledged in the design and use of systems. Attentive to the intentional and intersubjective character of human learning, data analytics can serve to optimise environments in which the imaginative and affective encounter is possible. The error of conflating such measures with the telos of human education must be avoided if education is not to be reduced to a series of fine-grained informational transactions. As measurement becomes ubiquitous in the social and educational world and machines gain exponentially in informational intelligence, it is essential that educators turn their attention toward making human learners more imaginative, responsible, cultivating attitudes of openness, gratitude and love toward knowledge. In so doing, it may indeed be possible to optimise the environment for that unique intentionality which characterises the education of persons.

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