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'Does it Make Sense' or 'What Does it Mean'?

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Abstract: This conceptual paper problematizes a distinction between *meaning-making* and *sense-making* as activities that support learning. In framing this distinction, various theoretical perspectives on sense-making are introduced from a range of disciplines that have direct implication for the ongoing development of the digital environment designed specifically to support learning. The digital environment is replete with choices that enable communication, information-seeking, knowledge sharing, computation, and learning – all made possible by a diversity of technologies. Semantics have a significant computational role in this environment and making sense of it, amidst constantly emerging capabilities, represents opportunities for innovation as well as challenges for digital learning. While meaning-making has a pivotal role in knowledge construction in this environment it is argued that sense-making often precedes it, thereby indicating a specific role for *sense-making technologies*.

Keywords: sense-making, sensemaking, meaning, semantics, sense-making technologies

1. Introduction

Human beings have been making sense of things for a very long time – no doubt, long before language was invented. While the milieu might be vastly different, making sense of things is as routinized today within digital learning contexts as it likely was in the Stone Age. It is a conscious human act that supports meaning-making, learning, and the development of understanding and reasoning skills – whether as a young child interacting with the world they have been born into or as a researcher immersed in analysis of disparate datasets and the received wisdom of relevant theory.

Despite its historical roots the term *sense-making* (also *sensemaking*) appears to have only entered academic discourse in recent times, finding traction as a construct across a broad range of disciplines. Some researchers trace its recent roots to the work of Bush (1945) in his visioning of the "Memex" (Chi and Card, 1999, p. 18). More explicitly, from the field of communications and information science, Dervin (1983; 1998; 2003) has described it as "a mandate of the human condition" (2005, p. 27); in human-computer interaction (HCI) Russell, Stefik, Pirolli, and Card (1993) define it as "the process of searching for a representation and encoding data in that representation to answer task specific questions" (p. 269), while in the context of intelligent systems development "the basic sensemaking act is [described as the] data-frame symbiosis" (Klein, Moon, and Hoffman, 2006, p. 88); in organizational development, Weick (1993) describes it as "structur[ing] the unknown … grounded in both individual and social activity" (pp. 4-6); and, in knowledge management, Snowden (2002) presents it in terms of a framework or model for dealing with complexity. It is also a term that has begun to appear in mainstream e-learning discourse such as *The Horizon Report* (Johnson *et al*., 2010, p. 3).

This paper draws upon all these perspectives while problematizing a distinction between *sense-making* and *meaning-making* for the following reasons. Firstly, it is often the semantic dimension of digital innovation (the Semantic Web and *semantic technologies* generally) that has captured the imagination of those visioning the next iteration of the digital revolution (Hendler, 2009). Secondly, it is arguable that "(t)he concept of meaning is every bit as problematic as the concept of mind" (Tiles, 1987, pp. 450-454). Thirdly, from a pedagogical perspective, constructivist theory highlights the role of meaning-making in the construction of knowledge but says little about sense-making. It is argued here that while sense-making is important in knowledge construction it does not necessarily invoke meaning-making and is an activity that has a prominent role in human-computer interaction.

2. Distinguishing Key Terms

A practical rationale for why this distinction is made is that making sense of things has utility as a turn of phrase (just as common sense has) while finding meaning in something is somewhat more problematic and can raise issues of subjective semantics and philosophy (such as vexed questions concerning the meaning of life). In many contexts *sense-making* and *meaning-making* are interchangeable. For example, in understanding how to respond when driving a car and approaching a red light: making sense of this situation and understanding the meaning of a red light are one and the same. In situations involving more complexity, such as understanding statutory legislation concerning carbon pricing, making sense of documentation may require reasoning, reflection, and analysis while the meaning of such a document might simply be understood as a mechanism to ameliorate climate change. Such meaning could be inferred prior to making sense of the documentation or after having done so but is not necessarily ascribed in the process/es of sense-making or essential to it.

2.1 Information and meaning

"we live in a universe where there is more and more information and less and less meaning" (Baudrillard, 1988, p. 95). Such an observation raises questions concerning the contemporary situation, such as whether web technologies ameliorate or exacerbate this. It also suggests that with less meaning-making perhaps there may be a clearer appreciation for the role of sense-making.

A key feature of information is that it can be described in terms of its semantic properties – for example, its context, subject matter, and provenance. Describing information this way is an essential practice for librarians when they catalogue it according to various classification schemes, the core of which can be reduced to generic semantics of *who, what, when*, and *where*. This core set of semantics has been described as the "primitives of information retrieval" (Mason, 2012) as they constitute the basis of most metadata schemas. The information contained within such metadata schemas is also largely factoid in nature and not subject to interpretation (Verberne, 2010) – and therefore, any associated meaning is not contestable. In learning contexts, however, content contains more than information – such as data, declarative knowledge, procedural knowledge, rich media, argumentation, and explanation. It is these dimensions of content that require both sense-making and meaning-making for learning to proceed (Mason, 2014; 2012; Mooney, 2011).

2.2 Linguistic perspectives

Linguistic perspectives also assist in making this distinction. As activities, both meaning-making and sense-making are verbs; however, the former is also primarily associated with the semantics of content, which is typically describable in terms of nouns and properties, or as propositions (as in the Resource Description Framework). As such, it is indicative of an end result or outcome – a naming, or "*nouning"*. In contrast, Dervin's (1999) articulation of her "Sense-Making Methodology" gives particular emphasis to the role of "verbing" and "Sense-Making is described as a verbing methodology … a methodology for communication practice" (pp. 731-736). Dervin (1998) also explains that her "approach to studying human sense making … has from its inception conceptualized knowledge and information as a verb" (p. 36). Dervin's later work also carries this strong emphasis where "Leadership 2.0" is described in terms of "knowledging" (Cheuk and Dervin, 2011).

2.3 Constructivism and meaning

As a term within educational contexts, such as constructivist discourse and "meaning-centered education" *meaning-making* is a pivotal construct (Kovbasyuk and Blessinger, 2013; Whiteside, 2007; Jones and Brader-Araje, 2002; Hein, 1999; Jonassen et al., 1999; Jonassen et al., 1995; Driver and Oldham, 1986). While there is variation in emphasis within the constructivist literature there is evidence to suggest that meaning-making and constructivism are terms that have sometimes been conflated:

> Is meaning making constructivism? Is constructivism meaning making? Short answers to these two questions are 'No' and 'Yes', respectively. The two terms, although frequently confused, are not synonymous … All discussions of constructivism include meaning making; but

meaning making (although often appropriately ca1led 'knowledge construction') does not necessarily imply constructivism. (Hein, 1999, p. 15)

What is arguably most important within constructivist theory, however, is the independent (though socially-situated) construction of knowledge – and both meaning-making and sense-making can be seen as contributing to this. The issue here is not whether the discernment or inference of meaning plays a major role in knowledge construction; it is whether it is intrinsic to it. Discernment or inference of meaning can be understood as sense-making activities but they do not define the scope of sense-making. The following discussion probes this distinction further.

2.4 Human-Computer Interaction and sense-making

Sensemaking has been a key consideration of Human-Computer Interaction (HCI) for over two decades (Russell, et al., 1993). HCI is a field of study that addresses diverse elements of interface design, semiotics, semantics of messaging, dialogic cues, usability and user control, media specifications, layout, navigation, and consistency, etc (Russell, et al., 2008; Russell, et al., 1993; De Souza, 2005; Rogers, Sharp, and Preece, 2011). Sensemaking in HCI spans all these topics as well as being a concern in its own right because it is a topic concerned with how the user can optimally interact with a computer and to achieve this the user needs to make sense of the interface as well as the content.

Recent HCI literature reveals a growing interest in sensemaking (Pirolli and Russell, 2011; Faisal, Simon, and Blandford, 2009; Paul and Morris, 2009; Klein, Moon, and Hoffman, 2006). Even so, it would appear that in a similar way that meaning-making and constructivism sometimes get conflated so does meaning-making and sensemaking in HCI. In paraphrasing Weick (1995) and Pirolli and Card (2005) Faisal et al. (2009) write that in broad terms "Sensemaking … is the process of *finding meaning from information*. As such, it is intrinsically linked with *information seeking* as both an outcome and a driver." (p.1) [emphasis added] Such a generalization may indeed be true for many situations that demand the parsing of information, but it also masks the underlying complexity and diversity of sense-making in which activities focused on gaining understanding do not necessarily produce meaning. A simple example is in processing the reasoning of an explanation. Nonetheless, Faisal et al. (2009, pp. 2-6) have proposed a practical (non-exhaustive) classification and "design methodology" of the variety of representations of sense-making used in HCI:

- Spatial – depicting objects and their spatial relationships
- Argumentational – representing proposition(s) and the logical operations that might link them
- Faceted – properties of an entity or entities within a domain
- Hierarchical – showing asymmetrical, one-to-many relationships
- Sequential – depicting a time series or chronology
- Network – depicting arbitrary, many-to-many relationships

From this scheme it can be seen that representations used in HCI sense-making involve a range of abstractions; however, at least two commonplace sense-making representations are missing from this list: firstly, symbols used in signs; and secondly, linguistic representations (textual or ideographic) in which semantics, syntax, morphology, and grammar all play important roles. It is also arguably the case that design innovations such as *infographics* also belong in this list as a *hybrid* or *aggregate* type.

2.5 Intelligent Systems and sense-making

Some concerns of HCI are shared by artificial intelligence (AI) – a field often referred to in recent years as *intelligent systems.* The application of AI within digital learning has typically been in the form of intelligent tutoring systems, although elements of intelligence can be seen in many common web and office software applications (such as suggested search terms or word corrections) and embedded into the design of the smart phone. It is within AI that the construct of the *frame* has been used for over four decades as a data structure that represents a viewpoint or set of assumptions (Minsky, 1974). The capability of representing everyday *common sense* as a manifestation of intelligence has been a fundamental problem for the AI community to solve from its beginnings. This problem of representing common sense continues today despite significant advances in the understanding and representation of context for any iteration of common sense representation (Lieberman and Havasi, 2012).

Of specific relevance to this paper is the presence of the frame as a pivotal construct within the "Data/Frame theory of sense-making" proposed by Klein, Moon, and Hoffman (2006b), in which it is the relationship between these two entities that matters most: "A frame functions as a hypothesis about the connections among data" (p. 88). In this theory, sense-making is presented as a cyclical process that *can* (though not necessarily *must*) involve assimilation, elaboration, questioning, doubting, and reframing. At various moments a hypothesis becomes plausible and this plausibility builds understanding. But is it the *meaning* of the hypothesis or its *reasonableness* that is preeminent when something becomes plausible? While it is the case that a frame(work) will likely have semantic content, sense-making is an activity conceived here as recognizing and postulating connections or relationships between data and frame and has an impact upon conceptualization and re-conceptualization. To characterize this process, or its goals, only in terms of meaning-making seems to diminish not only the process of sense-making but cognition itself.

2.6 Connectivism

The work of Klein, Moon, and Hoffman (2006a) has also found resonance for Siemens (2012) in his elaborations of his theory of connectivism since its first articulation (Siemens, 2004). It is not hard to see why: Klein, et al., suggest that "Sensemaking is a motivated, continuous effort to understand connections (which can be among people, places, and events) in order to anticipate their trajectories and act effectively" (Klein, Moon, and Hoffman, 2006a, p.71).

Siemens (2004) has proposed "connectivism" as a "learning theory for the digital age" in which technology networks are conceived as enabling new and rich connections to a diversity of entities all linked to continual learning and activities in which "the pipe is more important than the content within the pipe". The distinguishing characteristic of Siemens' theory is the prominent role of networks in creating connections between disparate learning sources and events (Siemens, 2005). Siemens' central insight regarding the role of networks is consistent with the sociological work of Castells (1996, 2001) in outlining the "rise of the network society" and in the work of Benkler (2006) on the "social production of intellectual capital". In some respects it also represents a re-articulation of connectionist theory grounded in mathematics that was first developed by Thorndike (1932) and later in the field of artificial intelligence (Pinker and Mehler, 1988). In presenting a recent, concise summary of connectivism, Downes (2014) states: "According to connectivism, learning is the formation of connections in a network." In the context of this paper, there is some alignment between connectivist (and connectionist) perspectives and sense-making although there are differences in conceptualization.

In the initial articulation of connectivism Siemens (2004) connects "meaning making" with learning but does not use the term sensemaking until some years later. But while the term "sensemaking" has found its way into the later discourse on connectivism (Siemens, 2012; Downes, 2011) it would appear that it is still very closely aligned with meaning-making: "Meaning-making is the foundation of action and reformation of viewpoints, perspectives, and opinions" (Siemens, 2006).

In recent work Siemens (2012) suggests "Sensemaking, then, is essentially the creation of an architecture of concept relatedness, such as placing 'items into frameworks'." This shows some similarity with the Data/Frame theory of Klein et al., but the definitive character of this statement can be seen as counter to Dervin's (1999) "verbing" perspective which gives emphasis to process rather than outcome. There is, however, a more important distinction to be made in terms of how "sensemaking" is used in connectivism and Dervin's work. For Dervin (1999), Sense-Making Methodology represents a research tool that is not aligned with any particular learning theory and is instead conceived as a "metatheory". In terms of this paper Siemens' representation of sensemaking primarily as "concept relatedness" also privileges the semantic domain and is not as richly presented as in the HCI discourse where mental representations are not necessarily in the form of concepts (such as scripts, models, and symbols).

Despite the differences in conceptualization, however, connectivism represents a plausible theory of how learning proceeds in some contexts – that is not being contested here. Its emphasis upon connections and connecting can also be seen as consistent with sense-making activities despite its limited depiction of sensemaking. As Downes (2014) argues "A connectivist account … look[s] well beyond rules and meaning."

3. Conclusion

This paper has been explicitly theoretical in addressing the distinction between sense-making and meaning-making. In determining the complexity of relationships between these two constructs it has been instructive to consider that semantic content represents just one of the functional components of natural language. Communicating in natural language would not be complete – or make much *sense* – without syntax, morphology, phonology, pragmatics, and grammar.

In very general terms the semantics of meaning-making suggest the formation of concepts and conceptual relationships. The semantics of sense-making suggests connection, causation, process, analysis, and probing. In learning, both activities are complementary. Yet it is also the case that both activities can function independently. This distinction suggests scope for developing technologies specific to supporting sense-making – as such, they might be identified as *sense-making technologies*.

References

Baudrillard, J. (1988). *In the shadow of the silent majorities or the end of the social*, (trans. P. Foss, P. Patton & J. Johnson). New York, NY: Senro text.

Benkler, Y. (2006). *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. New Haven: Yale University Press.

Bush, V. (1945). As we may think. *Atlantic Monthly, 176*(1), 101-108.

Castells, M. (1996). *The Rise of the Network Society – The Information Age: Economy, Society and Culture. Vol. I.* Oxford UK: Blackwell.

Cheuk, B. & Dervin, B. (2011). Leadership 2.0 in Action: a Journey from Knowledge Management to "Knowledging". *Knowledge Management & E-Learning: An International Journal, 3* (2), 119-137.

Chi, E. H., & Card, S. K. (1999). Sensemaking of evolving web sites using visualization spreadsheets. In *Info Vis'99 Proceedings, IEEE Symposium on Information Visualization* (pp. 18-25). IEEE

De Souza, C. S. (2005). *The semiotic engineering of human-computer interaction.* Boston, MA: MIT Press.

Dervin, B., Clark, K., Coco, A., Foreman-Wernet, L., Rajendram, C., & Reinhard, C. (2011). Sense-Making as Methodology for Spirituality Theory, Praxis, Pedagogy, and Research. Presented at the *First Global Conference on Spirituality in the 21st Century*, Prague, Czech Republic. Retrieved from http://www.inter-disciplinary.net/wp-content/uploads/2011/02/Dervin-paper1.pdf

Dervin, B. (2003). Given a context by any other name: Methodological tools for taming the unruly beast. In B. Dervin, L. Foreman-Wernet, & E. Lauterbach (Eds.), *Sense-making methodology reader: Selected writings of Brenda Dervin* (pp. 111–132). Cresskill, NJ: Hampton Press.

Dervin, B. (1999). On studying information seeking methodologically: the implications of connecting metatheory to method. *Information Processing and Management 35*, 727-750.

Dervin, B. (1998). Sense-Making Theory and Practice: An Overview of User Interests in Knowledge Seeking and Use. *Journal of Knowledge Management 2*(2), 36-46.

Dervin, B. (1983). An overview of Sense making: concepts, methods, results. International Communication Association annual meeting, Dallas, TX.

Downes, S. (2014). Connectivism as Learning Theory. *Half an Hour (Personal Blog).* Retrieved from http://halfanhour.blogspot.com.au/2014/04/connectivism-as-learning-theory.html

Downes, S. (2011). *Sensemaking artifacts.* Stephen's Web. Retrieved from http://www.downes.ca/post/56831

Driver, R., & Oldham, V. (1986). A constructivist approach to curriculum development in science. *Studies in Science Education*, *13*(1), 105-122. DOI: 10.1080/03057268608559933

Duffy, M. (1995). Sensemaking: A Collaborative Inquiry Approach to "Doing" Learning. The Qualitative Report. Retrieved from http://www.nova.edu/ssss/QR/QR2-2/duffy.html

Faisal, S., Attfield, S., & Blandford, A. (2009). A Classification of Sensemaking Representations (pp. 1–6). *Presented at the CHI 2009 Workshop on Sensemaking*, Boston, MA. Retrieved from http://discovery.ucl.ac.uk/14803/1/14803.pdf

Fisher, J., Norris, S., & E. Buie (2012). Sense-making in Cross-channel Design. *Journal of Information Architecture, 4*(1-2). Retrieved from http://journalofia.org/volume4/issue2/02-fisher/

Forester, J. (1985). Designing: Making sense together in practical conversations. *Journal of Architectural Education, 38*(3), 14-20.

Hein, G. (1999). Is meaning making constructivism? Is constructivism meaning making? *The Exhibitionist, 18*(2), 15-18.

Hendler, J. (2009). Web 3.0 Emerging. *Computer, 0018-9162/09*, 88-90.

Jahnke, M. (2013). *Meaning in the Making – Introducing a Hermeneutic Perspective on the Contribution of Design Practice to Innovation.* Doctoral Thesis, HDK – School of Design and Crafts, Faculty of Fine,

Applied and Performing Arts, University of Gothenburg. Retrieved from https://gupea.ub.gu.se/handle/2077/33428

Jonassen, D., Davidson, M., Collins, M., Campbell, J., & Haag, B.(1995). Constructivism and computer-mediated communication in distance education. *American journal of distance education, 9*(2), 7-26.

Jonassen, D. H., Peck, K. L., & Wilson, B. G. (1999). Learning to Solve Problems with Technology: A Constructivist Perspective (2nd Edition). Columbus, OH: Prentice Hall.

Johnson, L., Levine, A., Smith, R., & Stone. S. (2010). *The 2010 Horizon Report*. Austin, Texas: The New Media Consortium.

Jones, M. G., & Brader-Araje, L. (2002). The impact of constructivism on education: Language, discourse, and meaning. *American Communication Journal, 5*(3), 1-10.

Klein, G., Moon, B., & Hoffman, R. (2006). Making Sense of Sensemaking 2: A Macrocognitive Model. *IEEE Intelligent Systems*, *21*(5), 87–92.

Kovbasyuk, O., & Blessinger, P. (Eds.). (2013). *Meaning-centered Education: International Perspectives and Explorations in Higher Education*. New York, NY: Routledge.

Lieberman, H., & Havasi, C. (2012). Introduction to Special Issue on Common Sense for Interactive Systems. *ACM Transactions on Interactive Intelligent Systems, 2*(3). DOI: 10.1145/2362394.2362396

Mason, J. (2014). Theorizing *Why* in Digital Learning: Opening Frontiers for Inquiry and Innovation with Technology. In D. G. Sampson et al. (eds.), *Digital Systems for Open Access to Formal and Informal Learning*, DOI: 10.1007/978-3-319-02264-2_8

Mason, J. (2012). Scaffolding Reflective Inquiry – Enabling *Why*-Questioning while e-Learning. *Research and Practice in Technology Enhanced Learning 7*(3) pp.175-198.

Minsky, M. (1974). A Framework for Representing Knowledge. MIT-AI Laboratory Memo 306, June, 1974. Reprinted in P. Winston (Ed.), *The Psychology of Computer Vision*. McGraw-Hill.

Mooney, B. (2011). Know-that, know-how and know-why: the unity of knowledge. In T. B. Mooney & M. Nowacki (Eds.), *Understanding Teaching and Learning*, pp. 66-69, St Andrews Studies in Philosophy and Public Affairs, Exeter: Imprint Academic.

Paul, S., & Morris, M. (2009). Understanding and Supporting Sensemaking in Collaborative Web Search (pp. 1–6). *Presented at the CHI 2009 Workshop on Sensemaking*, Boston, MA.

Pinker, S., & Mehler, J. (1988). *Connections and Symbols.* Cambridge MA: MIT Press.

Pirolli, P., & Russell, D. (2011). Introduction to this Special Issue on Sensemaking. *Human-Computer Interaction, 26*, 1–8. doi:10.1080/07370024.2011.556557

Rogers, Y., Sharp, H., & Preece, J. (2011). *Interaction design: beyond human-computer interaction*. John Wiley & Sons.

Russell, D., Jeffries, R., & Irani, L. (2008). Sensemaking for the rest of us (pp. 1–7). Presented at the CHI 2008 Workshop on Sensemaking, Florence

Russell, D. M., Stefik, M. J., Pirolli, P., Card, S. K. (1993). The Cost Structure of Sensemaking. Proceedings, InterCHI '93 (pp. 269-276), Amsterdam, Netherlands.

Scheuer, O. &, Loll, F. &, Pinkwart, N., & McLaren, B. (2010). Computer-supported argumentation: A review of the state of the art. *Computer-Supported Collaborative Learning, 5*, 43–102.

Siemens, G. (2012). *Change MOOC: Sensemaking and Analytics.* Connectivism. Retrieved from http://www.connectivism.ca/?p=341

Siemens, G. (2004). *Connectivism: A learning Theory for the Digital Age.* Retrieved from http://www.elearnspace.org/Articles/connectivism.htm

Snowden, D. (2002). Complex Acts of Knowing: Paradox and Descriptive Self-Awareness. *Journal of Knowledge Management, 6*(20), 100-111.

Taylor, P. & Medina, M. N. (2013). Educational Research Paradigms: From Positivism to Multiparadigmatic. *Journal of Meaning-Centered Education 1*.

Thompson, E., & Stapleton, M. (2008). Making sense of sense-making: Reflections on enactive and extended mind theories. *Topoi*, *28*(1), 23–30. doi:10.1007/s11245-008-9043-2

Thorndike, E. (1932). *The Fundamentals of Learning.* New York: Teachers College Press.

Tiles, J. (1987). Meaning. In R. L. Gregory (Ed.), *The Oxford Companion to the Mind* (pp. 450-454). New York, NY: Oxford University Press.

Verberne, S. (2010). *In Search of the Why: Developing a system for answering why-questions.* Doctoral Dissertation, Radboud Universiteit, Nijmegen, The Netherlands.

Weick, K. E. (1995). *Sensemaking in organizations*. Foundations for Organizational Science. Thousand Oaks, CA: Sage Publications.

Whiteside, A. L. (2007). *Exploring social presence in communities of practice within a hybrid learning environment: A longitudinal examination of two case studies within the School Technology Leadership graduate-level certificate program*. Ann Arbor, MI: ProQuest.

Yang-Turner, F., & Lau, L. (2012). Human Factors in Forum Exploration: A Sensemaking Perspective. Retrieved from http://imash.leeds.ac.uk/event/pdf/Yang-Turner_11.pdf