Information, Thought, and Knowledge

Timothy R. Colburn
Department of Computer Science
University of Minnesota-Duluth
Duluth, MN 55812, USA
tcolburn@d.umn.edu

Abstract

This paper first analyzes the relationship between information and knowledge, arguing that having information does not necessarily require any of the traditional criteria of having knowledge. It then defends the thesis that to have information is to participate in a type of propositional attitude, so that information is the bare object of thought. The relationship between information and data is then examined, updating insights from early Wittgenstein.

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1 Information As Knowledge

From antiquity, philosophers have been concerned with the concept of knowledge, including its definition, analysis, scope, and origin. In epistemology, knowledge has been the focus of a centuries long debate between Rationalism and Empiricism on its foundation in the human understanding. The relationship of knowledge to observation and hypothesis has guided the development of the sciences. The structure and formal underpinnings of knowledge sparked the creation of modern logic.

The twentieth century saw the introduction of a related concept, that of information, into the popular and technical vocabulary. The ability to store information electronically as digital data led to the creation of notions such as information modeling, information theory, information technology, and the Information Society.

At the same time, the concept of knowledge escaped the philosophical confines of epistemology and entered the world of business and industry on the coattails of breathless hype over the applications of artificial intelligence. The 1970s introduced knowledge-based systems, the 1980s gave us knowledge engineering, and through it all there was a quest for knowledge representation that was both heuristically and epistemologically adequate.

The mantra of the Information Society is that "Knowledge is Power," and there seems on the face of it to be a quite intimate relationship between information and knowledge, as though they were two ways of talking about the same thing, or possibly that one was a species of the other. After all, the sentences "S knows that p" and "S has information that p" seem to be true in the same circumstances, and false in the same circumstances. Furthermore, an analysis of the root verb "to inform" gives more justification for the intertwining of information and knowledge. To say "$S1$ informs $S2$ that p" seems to presuppose that $S1$ knows that p before, and $S2$ knows that p after, an act of communication. It seems very reasonable to say, therefore, that information is knowledge in a form suitable for transferring or communicating.

This analysis is reflected in the first definition of "information" given by the Merriam-Webster Collegiate Dictionary: "knowledge obtained from investigation, study, or instruction." Certainly instruction is a mode of transferring knowledge between subjects. The other two modes, investigation and study, are ways for a subject to obtain knowledge without the direct involvement of another active subject. In any case, the term "information" in the popular vernacular seems very close to what philosophers mean by empirical knowledge, or knowledge gained through experience.

2 Problems With The Analysis

However, we run into a conundrum. Starting with Plato, philosophers have generally agreed that knowledge is *at least* justified true belief. That is, in order for a subject S to know that p, it must be the case that:

1. p is true,
2. S believes p, and
3. p is justified for S.

There have been debates about whether these are sufficient conditions for knowledge, but there is virtual unanimous agreement that they are necessary. [5]

Now, if S having information that p is the same as S knowing that p, then for every case of S having information that p, it must be the case that conditions 1–3 hold. Unfortunately, we can find examples showing that *none* of the conditions are necessary for S to have information that p.

2.1 The Truth Condition

If information is knowledge in a communicable form, then when we ask just what is it that is transferred during the communication of information, we are tempted to answer, "Why, the truth, of course." But suppose S is an intelligence worker for a national security agency, and so it is S's job to gather information about an unfriendly country. S reads espionage reports and intercepted communiqués, and in so doing has information that *terrorist X plans an attack on this country on the first of the year* (p). However, a similar agency for the unfriendly country is engaged in an effort to make this country believe that p despite the fact that p is not true; so the information p has been planted and used as a distraction to take attention away from other activity. Deliberate campaigns of *mis*information, or the dissemination of falsehoods to further political ends, exemplify information that is false and thus cannot be knowledge.

One might beg the question against this example and claim that "false information" is an oxymoron; S only *thinks* that he or she has information that p. But I think this would be an unparsimonious mistake. If S only thinks he or she has information that p, then what does S *really* have? Another cognitive category beyond information or knowledge would be necessary to answer this question. But another cognitive category is not required because we already have language that covers the situation: S only *thinks* he or she has *knowledge* that p, and actually has only information that p. The notion of false information may seem like an abuse of language only because most instances of information in their contexts also happen to possess further attributes that make them instances of knowledge. The repeated correlation of information and knowledge may result in the habit of regarding information as knowledge, and this habit may even creep into our dictionaries, but it is important to keep them philosophically distinct.

So then, while information does not have to be true, does it share any of the other conditions 2 or 3 for knowledge?

2.2 The Belief Condition

Let us consider the claim that if S has information that p then S believes p. If S is the intelligence worker from the previous example and he or she is particularly wary (and wants to confirm it, for example), then S is best described as having information that he or she does not believe. For another counterexample, consider any novel that spins a finely woven web of information about the lives of fictional characters. Along with the intelligence gathering example, such a work is an example of information that is not true, else it would not be a work of fiction. But it is also an example of the fact that, for S to have information that p, it is not even necessary that S *believe* that p. In reading *Crime and Punishment* S may have information that Raskolnikov murdered the pawnbroker, but S does not believe this in the same way that S believes, for example, that Booth murdered Lincoln.

But doesn't S believe that Raskolnikov murdered the pawnbroker in *some* sense, if not as a matter of objective fact then at least within the subjective context of the novel? But what could "believing within the subjective context of the novel" mean?

Philosophers have developed a device that might be helpful here, that of a *possible world*. Possible worlds have been invoked to provide semantics for certain types of modal logic [2], conditional statements [3], and default logic [1]. What is a possible world? The most straightforward answer is given by David Lewis:

> It is uncontroversially true that things might be otherwise than they are. I believe, and so do you, that things could have been different in countless ways. ... I therefore believe in the existence of entities that might be called 'ways things could have been'. I prefer to call them 'possible worlds'. [3, p. 84]

So one way of satisfying one's intuition, if one has it, that S believes something about Raskolnikov murdering the pawnbroker, is to say that S believes that the novel he or she is reading depicts a possible world in which Raskolnikov murdered the pawnbroker. That is, the actual world could have been such that a person named Raskolnikov exists and in which this person murders a pawnbroker. Call this possibility q. Not only might S believe q, but S might fear it, or be angered by it, or enter into any of a number of emotional attitudes about it that well written novels can elicit.

But of course, to say that S believes that q is not to say that S believes that Raskolnikov murdered the pawnbroker in the actual world. S's relation to the proposition "Raskolnikov murdered the pawnbroker" is minimal; S doesn't believe it, fear it, hope it, etc. S is simply presented with the statement and comprehends it. This minimal relation to a proposition p, I believe, constitutes "having information" that p. Before elaborating on this, however, I will give a third and final counterexample to the view that information is knowledge.

2.3 The Justification Condition

Among the many pseudoscientific endeavors, astrology is perhaps the most elaborate. There are many astrology books packed with what can be legitimately called complex and coherent *information* that predicts significant events in the lives of individuals. But none of this information is called knowledge by any legitimate scientist. Why? Since the predictions are based solely on celestial events at the time of an individual's birth, ignoring the more relevant facts attending specific times later in the individual's life, the predicted events are just as likely to not occur as to occur.

I mention this because it provides an example of how the information-as-knowledge thesis can fail condition 3 of the definition of knowledge. That is, for S to have information that p, it is not even necessary that p be justified for S. Suppose that in reading a daily horoscope, S has information that since he or she is born under the sign of Aries, in the next week he or she will have success in the stock market (call this prediction p). Suppose further that S is an avid astrologist, so S believes that p, and suppose even further that, fortuitously, p turns out to be true. Still, since it is well known that the stock market is unpredictable, S was not justified in believing p by any empirical standards. So, once again, S has information that p, but S does not know that p.

But if information shares no trait with knowledge, then what is it?

3 Information and Thought

So far we have considered the term "information" as it seems to be used in ordinary language, and we have used ordinary examples to show that information is not knowledge. As if recognizing the incompatibility of the two terms, the digital age has seen the concept of information evolve into one that is less related to the concept of knowledge and more related to the concept of *data*. Consider the following definition of "information" given in one of the most widely used technical dictionaries on the World Wide Web:

> Information is stimuli that has meaning in some context for its receiver. Some (if not all) kinds of information can be converted into data and passed on to another receiver. Relative to the computer, we can say that: Information is made into data, put into the computer where it is stored and processed as data, and then put out as data in some form that can be perceived as information. [6]

Beyond the characterization of information as stimuli for a receiver, this definition is less concerned with what information is as it is with the *representation* of information on machines as data, or the digital encodings that are stored and communicated as binary digits, or *bits*. Of course, information need not be represented only as bits in machines; data can also be constituted by splashes of ink on paper, or by light exposures on photographic film, or by glowing phosphors in a television picture tube. In any case, data of some form represents information, and the perception of this data by an appropriate receiver constitutes the communication of the information itself. But still, what is information itself?

According to the technical definition, data can exist independently of perceivers, but data becomes information when it is appropriately perceived. I would like to characterize "appropriately perceiving" in terms of the minimal relation to a proposition p that I mentioned at the end of section 2.2. To have information is to engage in the most primitive form of *propositional attitude*.

The notion of a propositional attitude of course presupposes the notion of a proposition. Philosophers generally regard propositions as the nonlinguistic entities *expressed* by linguistic entities such as sentences. Thus, for example, the proposition expressed by the English sentence "Raskolnikov murdered the pawnbroker" is the same as that

expressed by the equivalent sentence in Russian or French. Independent of any particular language, however, propositions are also regarded as the *objects* of various attitudes that thinking subjects can take in cognitive situations. Believing is one such attitude, as are hoping, fearing, wishing, etc. Whenever one takes such an attitude, it is a proposition that one believes, hopes, or fears, etc. The relationship in which a subject stands to a proposition when adopting a propositional attitude is one aspect of what philosophers call *intentionality*, and such attitudes are also sometimes called *intentional attitudes*.

Consider the most primitive type of attitude one can take toward a proposition p, in which p is neither valued in any way, as with hoping, fearing, or wishing, nor even believed; it is simply "placed before the mind" and *understood*. This attitude has sometimes been called the *entertaining* of a proposition and can be regarded as the generic foundation on which all thought is based. The philosopher H. H. Price expressed this very well:

> The entertaining of propositions is the most familiar of all intellectual phenomena. It enters into every form of thinking and into many of our conative and emotional attitudes as well. Indeed, one might be inclined to say that it is the basic intellectual phenomenon; so fundamental that it admits of no explanation or analysis, but on the contrary all other forms of thinking have to be explained in terms of it. [4, p.192]

I believe that the data-to-information process, that is, the process of S perceiving data in an appropriate way such that as a result S has information p, culminates in S entertaining p in the way just described by Price, and thus that information itself can be regarded as the bare object of thought. Information takes on the *added* feature of truth or falsity depending upon whether the basic entertained propositions are expressed by sentences that are true or false. Information comes to be believed, feared, hoped, etc. or not depending upon the psychological web of propositions that provides its context. Information comes to be justified or not depending upon the epistemological web of propositions that provides its support. But the concept of information itself is as basic as the concept of a proposition.

4 Data, Information, and Wittgenstein

Propositions are so often associated with sentences that one might object that this account ignores the role of such nonalphabetic data as is used in photos, video, and music. But propositions are not limited to representation by alphabetic data such as that presented on this page or in word processing programs. With L. Wittgenstein, we can say that propositions are *pictures* that represent reality, either accurately or inaccurately. [7, paragraph 4.01] Picturing, of course, is a natural way of describing what photos and musical scores do. But how is it that our alphabet of abstract symbols in the form of letters can be said to picture, or *depict*? Wittgenstein noted that,

> In order to understand the essential nature of a proposition, we should consider hieroglyphic script, which depicts the facts that it describes. And alphabetic script developed out of it without losing what was essential to depiction. [7, paragraph 4.016]

I believe that this insight, first published in 1921, also says something about the relationship between our modern notions of data and information. Information in verbal language can be depicted by the ones and zeros of data because binary codes (for example, American Standard Code for Information Interchange (ASCII), or the more recent Unicode) were developed out of alphabetic script without losing what was essential to the alphabet. Information in photographs can be depicted by the ones and zeros of data because binary codes (for example, the Joint Photographic Experts Group (JPEG) format) were developed out of what was known about color representation without losing what was essential to that representation. Similarly for musical information.

The psychological mechanisms of how data becomes information for a perceiver is a question for cognitive science, but I believe some comments Wittgenstein made in the context of music suggests something relevant about the *logical* relationship of data and information:

> There is a general rule by means of which the musician can obtain the symphony from the score, and which makes it possible to derive the symphony from the groove on the gramophone record, and, using the first rule, to derive the score again. That is what constitutes the inner similarity between these things which seem to be constructed in such entirely different ways. And that rule is the law of projection which projects the symphony into the language of musical notation. It is the rule for translating this language into the language of gramophone records. [7, paragraph 4.0141]

Although Wittgenstein did not couch his theories in terms of data and information, I think there is a correspondence between his "law of projection" and the relationship between data and information. A symphony is a repository of musical information that is perceived when the symphony is performed or played through a recording. Its data, which can be, variously, its musical score, or a groove on a gramophone record, or bits encoded on a compact disk, etc., is suitable for storage. The law of projection, (for which Wittgenstein used geometric projection as a metaphor) is responsible for relating, for example, the score, as data, to the symphony itself, as musical information, in a language-to-language translation.

In the context of the digital age, perceived information is embedded in the alphabetic characters, or screen pixels, or sounds that are generated by a machine from data as ones and zeros. In appealing to his so-called law of projection, Wittgenstein foreshadowed the current history of computer science, which has seen the careful construction of layer upon layer of linguistic abstractions upon the basic foundation of ones and zeros, and the excruciatingly tedious rules of translation (projection) between these linguistic layers.

But mere translation between layers of linguistic representation must not be confused with having information. The formal translation among levels of representation intrinsic to computer science only applies to data representations. To be data does not require a thinker. The representation of a symphony, however, since it exists through perception, does require a thinker. But this is in keeping with our characterization of information as the bare object of thought, since a symphony comprises musical information. And so to be information requires a thinker.

Whatever the relation is between bits on a compact disk and the perceived symphony, it must bridge the formal language of data and the representational language of thought. Much has been said about the relation between these two types of language. It is tempting to be dazzled by today's machines' unparalleled data processing abilities, along with the unfathomably complex nature of the data structures they manipulate, and to slip into talking about the machines as *information* processors. But to do so would be to claim that machines think, since to have information is to adopt an intentional attitude. So unless one is prepared to describe exactly what it is to entertain propositions, and to argue for the claim that machines routinely so entertain them, one should refrain from talking about machines as information processors in favor of their more innocuous characterization as data processors.

References

[1] Ginsberg, M.L. and Smith, D.E. "Reasoning About Action I: A Possible Worlds Approach," in M.L. Ginsberg, ed., *Readings in Nonmonotonic Reasoning*, Los Altos, CA: Morgan Kaufmann, 1987, pp. 433-464.

[2] Kripke, S. "Semantical Considerations on Modal Logic." *Acta Philosophica Fennica*, Vol. 16, 1963, pp. 83–94.

[3] Lewis, D.K. *Counterfactuals*. Cambridge, MA: Harvard University Press, 1973.

[4] Price, H.H. *Belief*. London: George Allen and Unwin, 169.

[5] Roth, M.D., and Galis, L., eds. *Knowing: Essays in the Analysis of Knowledge*. New York: Random House, 1970.

[6] Whatis.com. Definitions copyrighted by and used with the permission of whatis.com (http://whatis.com) and TechTarget.com, Inc.

[7] Wittgenstein, L. *Tractatus Logico-Philosophicus*. London: Routledge and Kegan Paul, 1961.