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## Relevance and Creativity—A Linear Model

### Abstract

**Purpose**—The purpose of this paper is to provide a new and useful formulation of relevance.

**Design/methodology/approach**—This paper is formulated as a conceptual argument. It makes the case for the utility of considering relevance to be function of use in creative processes.

**Findings**—There are several corollaries to formulating relevance as a function of use. These include the idea that objects by themselves cannot be relevant since use assumes interaction; the affordances of objects and how they are perceived can affect what becomes relevant but are not in themselves relevant; relevance is not an essential characteristic of objects; relevance is transient; potential relevance (what might be relevant in the future) can be distinguished from what is relevant in use and from what has been relevant in the past.

**Originality/value**—The paper shows that its new formulation of relevance brings improved conceptual and terminological clarity to the discourse about relevance in information science. It demonstrates that how relevance is articulated conceptually is important as its conceptualization can affect the ways that users are able to make use of information systems and, by extension, how information systems can facilitate or disable the co-production of creative outcomes. The paper also usefully expands investigative opportunities by suggesting relevance and creativity are interrelated.

**Keywords**—Relevance, Creativity, Theory, Document, Affordance.

**Paper type**—Research Article

### 1. Introduction

The concept of relevance has long been considered central to information science, especially in the empirical evaluation of information retrieval systems. However, understanding of relevance has remained unsatisfactory in both theory and practice. The word “relevance” has been used liberally in many different ways and contexts. The meaning has been made more diffuse by the use of “relevant” instead of “related” for anything related to relevance. We propose a concise, precise reformulation of relevance. Documents have featured centrally in discussions of relevance and we use the term as shorthand for the great variety of things, interactions, and concepts that have historically been associated with documents, as well as more recent discourses related to documentality and documentarity. (See Buckland, 2017, for a summary).

Relevance, we propose, involves documents in use. *A document is relevant when it is in use*. When not in use, documents are potentially relevant. Documents that have been used in the past have been relevant historically. They might become relevant again, but, when no longer in use, they are no longer relevant, only potentially relevant. In this view, relevance is a state of being, the state of being in use. The term *use* suggests its ordinary “senses relating to utilization, employment, or application” (Oxford English Dictionary s.v. “use”).

The use of documents assumes interaction and mental processes that generate change. Relevant documents, therefore, are those that are made use of in creative processes where “creative” is not meant to suggest any Romantic ideal of an inspired genius but simply the composing of a changed circumstance. This formulation understands relevance to contribute in an act of composition. By this we mean that documents in use, i.e. relevant documents, are “parts” and “elements” brought together in processes that “make up,” “form,” “fashion,” “construct” and/or “produce” (*Oxford English Dictionary*, s.v. “compose”) new circumstances. We assume cognitive activity takes place when documents are put to use. Similarly, we assume cognitive activity takes place while documents are being used. But otherwise we take no position on the mechanisms of cognitive activity.

There are several corollaries that follow from our reformulation. It follows that documents *by themselves* cannot be relevant since use assumes an interaction. Similarly, the *affordances* of documents and how they are perceived in use can affect what becomes relevant but are not in themselves relevant. Relevance is not an essential characteristic but a momentary attribute. Documents and their affordances become relevant *in use*. Hence, relevance is *transient*. Actual relevance, our shorthand for “documents in use in creative processes,” is importantly distinct from potential relevance (what might be relevant in the future) and from having been relevant in the past.

There are similarities between our proposal and previous models of relevance. For example, like Saracevic, when he summarizes early research on relevance (1975, 2007), we say that relevance concerns “interaction,” is subject to “change,” and “has a context” (2007, p. 1920). Dan Sperber and Deirdre Wilson (1986, 1995) examined speech acts, which informed the work of Stephen Harter (1992) and others investigating relevance as a psychological phenomenon, as well as what might be thought of as a phenomenological strain of thinking about relevance in daily life inspired by the work of Alfred Schutz. (See Strassheim, 2010, for a good comparison). Similarly, relevance for us concerns interaction in context. But there are significant differences between our formulation of relevance and previous formulations. Where Sperber and Wilson are concerned with the “idea that there is a single property—relevance—which makes information worth processing for a human being” (*Relevance: Communication and Cognition*, Second Edition, 1995, 46), we do not assume that relevance is a single property or make any claims about worth in relation to human information processing. Nor is relevance a “relation” between certain “assumptions” and certain “contexts,” as Harter (1992) summarizing Sperber and Wilson suggests, since the notion of *in use* entails entanglement rather than clearly delineated relations. Where for Sperber and Wilson, as well as Schutz, relevance concerns processes related to selection (Strassheim, 2010), relevance for us does not. Where Schutz, Sperber, and Wilson’s discussions of relevance focus on “what leads a concrete individual in concrete circumstances to select this rather than that?” (Strassheim, 2010, 1414), our discussion of relevance concerns what has already been selected and is in use.

Hjørland and Sejer Christensen (2002, p. 1919) suggest the following model of relevance: “Something (A) is relevant to a task (T) if it increases the likelihood of accomplishing the goal (G), which is implied by T”. Saracevic (1975, p. 328) had provided the following: “Relevance is the A of a B existing between a C and a D as determined by an E,” where A may be a “measure, degree, dimension, estimate . . .;” B may be “correspondence, utility, fit, . . .;” C may be a “document, information provided, fact . . .;” D may be “query, request, information requirement . . .;” and E may be “user, judge, information specialist...” Saracevic suggested in 2007 that

“almost every definition [of relevance] offered still fits this pattern” (2007, p. 1919). He goes on to articulate the “attributes of relevance in information science”:

We consider relevance as having a number of dimensions or attributes: Relevance is a relation. Relevance is a property. Relevance is a measure. Relevance has a context, external and internal. Relevance may change. Relevance has a number of manifestations or kinds. Relevance is not given. Relevance is inferred. Relevance is created or derived. Relevance involves selection. Relevance involves interaction. Relevance follows some intentionality. (p. 1920)

We might express our own approach as follows: Something afforded by D and perceived by A in context C is relevant for A while A is using what is afforded by D. A is an actor and D is a document. In our approach relevance is not a relation, but a state of being in relation. Relevance is not a property or a measure, although measures and properties can be used to predict relevance in future use and to make historical judgements about what has been relevant (i.e. has been made use of). The state of being relevant is transient. Relevance has a context (which is also transient), but we do not make firm distinctions between what might be internal and what might be external context. Relevance as use by an actor of something afforded by a document may result in any number of manifestations and outcomes, but relevance as a status is distinct from these manifestations and outcomes. Relevance is not given, nor is it inferred, although it is commonly predicted. Relevance is not created or derived but a state of being in use that is generative of a new circumstance, which might be judged post hoc to be derivative or creative (in the sense of being novel and useful). Relevance is premised on selection. Relevance does not involve interaction but is interaction. Relevance does not assume or depend on an identifiable task or goal.

In summary, for Saracevic and for the field if his claims are to be taken at face value, relevance concerns both predictions about relevance and judgements about what has been relevant. Our model enables distinctions between predictions, retrospective judgements, and actual relevance and thus facilitates conceptual clarity.

In what follows, we provide some comments on conceptual inadequacies in prior discourse about relevance. This is followed by a brief discussion of creativity studies that highlights an overlap between understandings of relevance in information science and creativity in creativity studies. A discussion of the ways that our reformulation of relevance clarifies relevance and improves it as a conceptual tool then follows, along with corollaries that follow from our reformulation. This discussion of corollaries leads into a description of the stakes involved in formulations of relevance since, as we argue, the formulation of relevance can affect the ways that information systems articulate contexts that can enable (or disable) productive work.

## **2 Discourse about Relevance**

### *2.1 Past and current discourse*

The information science literature concerning relevance is extensive. Our summary here is meant only to present some of the discourse’s general themes and provide some clarifying distinctions between what has been described as relevance in the past and what we are proposing. Many useful reviews (e.g., Saracevic, 1975 and 2007; Ellis 1984; Robertson and Hancock-Beaulieu, 1992; Froehlich, 1994; Schamber, 1994; Mizzaro, 1997; Borlund, 2003; Hjørland, 2010; White,

2007 & 2018) are available as starting points if a more detailed and comprehensive review of the literature is desired.

As noted above, it is broadly agreed that relevance is both central to information science and theoretically fraught. One thoughtful review begins:

Relevance is widely acknowledged to be both the most fundamental issue of information science as a discipline and the most central concern of information and document retrieval systems as applications. . . . But from a theoretical point of view, about the only aspect of relevance that is agreed upon is how difficult it is to predict what information, documents, and/or texts will be found relevant to a given user need. (Bean and Green, 2001, p. 115).

Thomas Froehlich (1994, p. 124) ably summarized some of the theoretical difficulties:

(1) The inability to define relevance; (2) the inadequacy of topicality as the basis of relevance judgments; (3) the diversity of nontopical, usercentered criteria that affect relevance judgments; (4) the dynamic and fluid character of information seeking behavior; (5) the need for appropriate methodologies; and (6) the need for more complex, robust models for system design and evaluation.

Attempts to organize the discourse about relevance have led to discussions of classes and types of relevance. Focusing on relevance in information retrieval, Borlund (2003), for example, following Saracevic (1975), Swanson (1986), and Harter (1992), suggests that there are two broad classes and many types of relevance. “The two classes are: (1) objective *or* system-based relevance; and (2) subjective *or* human (user)-based relevance” (p. 914). Following Saracevic (1996), Borlund (2003) suggests that there are five basic types of relevance. The first, “system or algorithmic relevance,” “describes the relation between the query (terms) and the collection of information objects expressed by the retrieved information object(s)” (p. 914). It belongs to Borlund’s first relevance class. “Topical-like type,” or “aboutness,” is a second type of relevance. “Pertinence *or* cognitive” relevance, “situational” relevance, and “motivational *or* affective” relevance are additional types of relevance (Borlund 2003, 914). These last four types of relevance belong to the “subjective” class of relevance types in Borlund’s scheme. To this list of types of subjective relevance, Borlund adds Harter’s (1992) “psychological relevance” as he adapts it from Sperber and Wilson (1986), as well as others. This organization of the relevance literature is helpful, though, as we describe in more detail below, Patrick Wilson (1973) famously argued for understanding “situational relevance” as a kind of logical relevance, which would make it an object or system-based relevance in Borlund’s schema.

More recent thinking reflects this history. The *Encyclopedia of Library and Information Sciences* (McDonald & Levine-Clark, 2018), for example, has two very different and contrasting articles on relevance. One is a competent summary of the pervasive practical use made of relevance in the measurement of information retrieval system performance and is based on the usual convenient but unrealistic assumptions, e.g., that relevance is binary, stable, and can be judged reliably by third parties (Cosijn, 2018). This could be understood as a summary of system-based types of relevance. The other is an excellent, thoughtful review of relevance theory by Howard D. White, who concludes that relevance is understood subjectively quite well, but that it will always be measured crudely. White’s definition of relevance, one that fits nicely into Borlund’s subjective class, is “the ability of a document to produce in the mind of a user

*valuable cognitive effects without undue processing effort*" (White, 2018, p. 4509. Emphasis in original.) For a forceful denunciation of system-based relevance see Ellis (1984).

The relevance discourse has also been organized by the idea of need. A broad theme in the literature is that relevance should be understood as a relationship between a document and a need. Documents, needs, and relationships have been variously defined or assumed, sometimes without definition. Arafat and Ashoori (2019), citing Borlund (2003) who summarizes Robertson and Hancock-Beaulieu (1992) who cite Taylor (1968), points to a "relevance revolution" beginning in the late 1960s. The "revolution" concerned ways of thinking about need. According to Robertson and Hancock-Beaulieu (1992), Taylor's 1968 "Question-Negotiation and Information Seeking in Libraries" was a turning point after which "there has been increasing acceptance that stated requests are not the same as information needs, and that consequently relevance should be judged in relation to needs rather than stated requests" (3). This line of thinking can be associated with the subjective class of relevance types since the information needs of an information seeker are not thought to be represented by seekers' queries. In other words, relevance "should be judged on the information need behind a request rather than on the request itself" (Arafat and Ashoori 2019, 272), or even expanded to "focus not only to the needs of the immediate user (i.e., the personal information need), but also to the social factors influencing the forming of these needs" (Arafat and Ashoori 2019, 272).

Woven into the discourse on relevance as counterpoint were the arguments of scholars such as Cooper and Wilson who each in 1973 considered forms of logical relevance premised on the idea that information requests can be seen as a reasonable representation of user need. As Wilson (1973) put it, "whatever view and concerns a man has can be represented" (461). Cooper defined relevance "as a relationship holding between pieces of information on the one hand and user's information needs formulated as information need representations on the other hand" (Cooper 1973, 22 as cited in Wilson 1973, p. 459). Wilson's (1973) well-known but less-well understood arguments concerning "situation relevance" are efforts to "articulate one of the main sorts of things we would like" (p. 470) for an information system to provide. In the case of information retrieval systems, according to Wilson (1973) we would want a "regular supply of significant situationally relevant information" (p. 470), where significant information is "directly relevant situationally" and situational relevance concerns "items of information" that "answer, or help answer [logically not psychologically], questions of concern" (p. 463). "Direct" situational relevance concerns items of information that are that are members of "a concern set," (p. 463) i.e. a "set of all the statements each of which is a possible answer to a question about some feature of concern, and among which one has preferences" (p. 461). Arguments that follow Cooper and Wilson's lead might be situated in the "objective or system-based" class of relevance since they concern systems of deductive and inductive inference that will answer or "or logically help to answer, questions of concern" (Wilson 1973, p. 457).

Attempts to address what might be thought of as both classes of relevance simultaneously have been made. Arafat and Ashoori (2019), for example, borrowing from Aristotelian philosophy and phenomenology of Heidegger and Schutz, suggest relevance is related to "technological activity" in the Heideggerian sense of objects being revealed through tool-based interactions and formal causes in an Aristotelean sense where objects are brought into being, at least in part, by their formal shapes. For Arafat and Ashoori, this makes relevance closely related to signification. They suggest that "'x is relevant to y' [should] denote 'x means y,' or 'x signifies y,' or 'x and y mean or signify one another'" (2019, 273).

## 2.2 Objective and subjective relevance: Predictors of and surrogates for relevance

As we see, significant threads in the discourse about relevance do not actually focus on relevance or, if they do, they associate relevance with beliefs about user needs or equate relevance with concepts, such as signification. In the discourse, the term *relevance* often suggests predictors of or surrogates for relevance. In the case of Patrick Wilson, we have a way of thinking that can help to clarify what we might wish for an information system to provide.

The ways that objective and subject relevance have been made to predict or stand in for relevance can be made clear with a few historical and some more recent examples. John Budd has cited a paper by two respected experts, Michael Lesk and Gerard Salton (Lesk & Salton, 1968; Budd, 2001, pp. 292-3). In a paper entitled “Relevance assessments and retrieval system evaluation” that appeared the same year as Taylor’s “Question-Negotiation and Information Seeking in Libraries,” Lesk and Salton describe an evaluation of a retrieval system used to search in a collection of article abstracts. Numerous written queries were written. The abstracts were considered in relation to each query and judged to be either relevant or not relevant. The authors explain that

. . . the relevance criterion to be used was a strict one, in the sense that relevance of a document was to be specified only

‘if it is directly stated in the abstract as printed, or can be directly deduced from the printed abstract, that the document contains information on the topic asked for in the query.’

Since each query presumably represented an information need, an abstract would thus be called relevant if the author [of the query] felt that given the abstract he would with great probability wish to consult the complete document. (Lesk and Salton, 1968, pp. 347-348).

Other subject experts also judged the same pairs of queries and abstracts and little agreement between judges was found. The approach described is a pragmatic solution to a practical problem, but the use of binary judgements and the assumption that the relevance of a document is independent of the relevance of other documents are gross simplifications. This approach is defensible as a practical engineering procedure but less defensible as science. The relevance judgements of experts, even though inconsistent, may provide some useful predictions concerning which documents might be useful for some user, but it is an exaggeration to say that these judgements measure relevance. Although the technology used has changed, similar principles are at work in areas of study associated with newer areas of interest such as knowledge graphs and domain discovery, which concerns “acquiring a relevant corpus of data from the web” (Kejriwal, Knoblock, Szekely, 2021, p. 53). To create knowledge graphs, web crawlers and what are called domain discovery tools are built using human-labeled data, the equivalent of what was produced by Lesk and Salton’s expert judges, along with statistical representations of topicality and lexical similarity (See Kejriwal, Knoblock, Szekely, 2021, especially chapter 3). Lexical similarity, topicality, and the ratings of relevance judges are commonly associated with the term “objective relevance”.

*Objective relevance*, as we have been discussing, is a term of art that attempts to position relevance so that it is not tied situationally to a specific individual. It has the advantage of not requiring consideration of individual users’ existing knowledge, purposes, or cognitive activity.

Objective relevance is best seen as a predictor of actual relevance. There are three common forms of objective relevance:

- (1) External relevance judgements made by individuals other than prospective users can assess probable future relevance. A panel of relevance judges is often employed in the evaluation of retrieval system performance, as in the Lesk and Salton example. There is ordinarily disagreement among the judges on relevance judgements and, even if there were agreement, there is no assurance that it will agree with the future subjective judgement of any other living subject. Nevertheless, it is a feasible procedure that echoes the use of readers' advisors in public libraries and, more generally, anyone else consulted as an expert advisor. The importance assigned by librarians to the reference interview reflects the significance of the potential difference between an external judge (e.g. the reference librarian) and a reader.
- (2) Topical relevance or, more accurately, topical similarity, occurs when two documents, or a document and a query, appear to discuss the same topic, as in the Lesk and Salton example above. The questionable assumption is that a document that discusses the same topic is likely have utility for an inquirer and that therefore topical similarity can serve as a predictor of relevance (i.e. use). The inaccessibility and instability of cognitive processes and purposes make topical similarity a convenient and stable surrogate for relevance. Harter (1992) provides examples of relevance without topical similarity, but topical similarity is compellingly convenient as a predictor because it can be inferred from existing subject indexing, subject classification, and terms used in the text. Topical similarity conveniently avoids taking the individual inquirer's knowledge and cognitive needs into account.
- (3) Lexical similarity is when occurrence of words with the same or similar spelling are used to indicate probable topical similarity and, thereby, probable relevance. This is the primary method of web search engines, with some refinements using disambiguation, vocabulary control, contextual clues, and prior associations.

Rather than formulating objective measures of a phenomenon that can be called relevance, these measures of "objective relevance" are predictors of what might be relevant if put into use. In other words, these forms of objective relevance are standards for predicting but not for describing relevance.

When considered in the order above, objective relevance techniques are efforts to shift the work of making predictions about documents and their use from humans to algorithmic procedures. In Julian Warner's terminology, relevance judges exert semantic labor, lexical similarity is derived by syntactical labor, and topical similarity could use either (Warner, 2021). These three forms of objective relevance are also progressively less effective where irony, allusion, and figurative language are involved. They provide increasing convenience and economy of effort, but are not "objective" descriptions of relevance. This discrepancy between what terms like objective relevance would seem to suggest and what they actually mean has created a variety of conceptual complications that a narrower definition of relevance can avoid. The same can be said of terms associated with subject relevance where the focus is on states of



mind as they are formulated by individual psychology and social circumstance rather than relevance itself. We note for example, that what has been cited as a seminal paper in the “relevance revolution,” Taylor’s 1968 essay, does not actually concern relevance but rather how librarians can be trained and “self-help” aids can be organized to best manage the negotiation between an information seeker and a library system.

### 3 Relevance

#### 3.1 A narrower definition

To resolve problems in discourse about relevance, we propose that the terms *relevant* and *relevance* be applied only to documents in use in creative processes. This narrower formulation of relevance helps to resolve some of the conceptual difficulties. Our proposal is to understand relevance not as a prediction about what might be perceived as likely to be useful in the future or a historical judgement about what has been useful in the past, but as something actually in use in an ongoing process. There is for any event an important difference between the possibility of something happening and its actual happening. (Consider death or winning a lottery!)

Distinguishing actual relevance from the prospect of possible future relevance leads to a further distinction between predictions of relevance made before the event and judgements of relevance after the event. Using *relevance prediction* for the former and *relevance judgement* for the latter would be clearer than current practice of simply using *relevance* for both.

Distinguishing actual relevance from situational relevance—i.e. from information that answers, or might logically answer, questions—is similarly useful since an answer to a question may not be the only reason to use a document. Relevance as a document or documents in use allows for logic, answer seeking, and even the aspiration of finding a means to describe what we might want from an information system, but does not rely on them for its validity as a term.

Distinguishing actual relevance from other terms such as significance is useful for conceptual clarity.

#### 3.2 The relevance paradox

Suggesting relevance be understood as a document in *use* creates a paradox. Being relevant ensures that a document will, when not in use, cease to be relevant. This transience of relevance clarifies several useful consequences of reformulating relevance. First, the transience of relevance provides a clear distinction between (1) possible future relevance, (2) actual relevance in action, and (3) belief (logical, psychological, or both) that something was relevant in the past. Adopting this reformulation clarifies how relevance in the discourse has hitherto referred primarily to (1) and (3), including how (3) might predict (1).

Second, it allows us to assume a document has been expected to provide some utility or satisfy some need, else it would not be in use. This is conceptually productive because it allows utility and need, terms with multiple definitions in the relevance literature (see Saracevic 1975 and 2007) to be identified without relying on specific theories of cognition, psychology, work, or utility. If what is afforded by an object or idea is in use, we can be sure it was regarded as having some “relation to” matters in hand (*Oxford English Dictionary*. s.v. “Relevance”) even if we are unsure about why or how much.

The relevance paradox also clarifies the relationship between relevance and novelty. The use of a document in some process ensures that it contributes to a new circumstance. But the use

of documents says nothing about how to judge the novelty of the new circumstance they helped to produce or whether the document was novel to a user before it was used. The later issue, like topicality (discussed above), has been a central interest in information retrieval as it concerns the determination of relevance (Yu and Santos, 2012). The relevance paradox helps to clarify that novelty as it is variously defined in information retrieval is relevance prediction when it is used to predict the use of a document. How to judge the novelty of a new circumstance that results from the use of a document concerns relevance judgements and, as we describe next, creativity.

## 4 Creativity

### 4.1 *Creativity and relevance*

While there is no widely accepted theory of creativity (Kozbelt, Beghetto & Runco, 2010), there is a consensus that creativity, like relevance, involves novelty and utility. “Most people believe that creativity is original or novel thought and behavior, but in truth, the consensus among researchers is that it involves not only original/novel thought but also meaningful and useful thought and behavior” (Feist, Reiter-Palmon & Kaufman, 2017, p. 1). In a similar formulation, Kaufman & Glăveanu (2019) write, “There is reasonable consensus regarding the definition of creativity, which is that it is something both new and task-appropriate” (p. 27). There is also a consensus that creative thought is not different in kind from ordinary thought (e.g. Weisberg, 1993). For more on creativity see Shiu (2014), Smith, Ward, & Finke (1995), Ward & Kolomyts (2010) and, more generally, also Kaufman & Sternberg (2010 & 2019),

Although it has apparently gone unnoticed, relevance in information science and creativity in creativity studies overlap conceptually. They both have been formulated to concern novelty and utility. As we have formulated relevance, judgements about the outcomes associated with documents in use (e.g. a document’s utility) can be considered relevance judgements. According to consensus definitions of creativity, they can also be seen to be judgements concerning creativity, judgements about whether the use of a document has brought about a usefully novel circumstance. It is these conceptual intersections that lead us to suggest that relevance and creativity should be understood as related in acts of composition, by which, again, we mean that documents in use (relevant documents) are elements in processes that fashion, form, or otherwise produce circumstances that can be judged post hoc to be usefully novel, i.e. creative and useful.

### 4.2 *Newton’s apple*

To suggest how relevance and creativity can be understood to be interrelated in the composing of new ideas and circumstances, we use the story of Newton’s apple. Newton reminisced to William Stukeley, his biographer, about a famous example of creative thought. He was sheltering at home during a plague and a falling apple inspired his theory of universal gravitation:

... the notion of gravitation came into his mind. It was occasion’d by the fall of an apple, as he sat in a contemplative mood. Why should that apple always descend perpendicularly to the ground, thought he to himself. Why should it not go sideways or upwards, but constantly to the earths centre? Assuredly, the reason is, that the earth draws it. There must be a drawing power in matter: and the sum of the drawing power in the matter of the earth must be in the earths center, not in any side of the earth. Therefore dos this apple fall perpendicularly, or towards the center. If

matter thus draws matter, it must be in proportion of its quantity (Stukeley, 1752/1936, p.20, original spelling; Keesing, 1998, 383)

Newton's idea of universal gravitation has been judged to be novel and useful and, therefore, creative. Although we can say the apple was relevant to his insight, current approaches to relevance in information science would not accommodate the relevance of Newton's apple to his theorization of gravity. Writings by Galileo, Kepler, and others concerning the motion of objects were known and available to Newton and might have been recommended to him as relevant by modern systems for predicting relevance if they had been available. Our modern systems would be unlikely to have recommended "apple" as relevant to Newton's interests in the dynamics of moving objects. The topic "apple" would not have been helpful. No panel of experts would have judged apples to be relevant to theories of bodies in motion. Nor is there a lexical similarity between "moving bodies" and "apple." Descriptions of Newton's psychological circumstance, however they might have been formulated then or now, are also unlikely to have predicted the relevance of the apple.

By formulating relevance as the status of being in use in creative processes and regarding creativity and relevance as related in composition, it is easier to formulate the apple as relevant to Newton in a manner that aligns with colloquial understandings of relevance, if not widely used conceptions of predictive relevance in information science. While Newton used the apple in the creative processes of formulating theories of gravity, the apple was relevant even if we cannot know how, exactly. In the story of Newton and his apple we can be sure some feature of the apple, such as its habit of "descending perpendicularly," incorporated by Newton into his consideration of moving bodies "produced" new circumstances we recognize as his theory of gravity.

#### *4.3 Invention and innovation*

Where Newton and his apple provide a clarifying historical example of the relationship between creativity and relevance we are suggesting, concepts from economics enable a clarifying analogy. In *Business Cycles: a Theoretical, Historical, and Statistical Analysis of the Capitalist Process*, Joseph Schumpeter (1939) distinguishes between *invention* and *innovation* in a manner that is useful for our discussion of relevance and creativity. For Schumpeter, "innovation consists in giving effect, by business action, to a particular invention" (85). Where inventions are opportunities presented by a context because they have "emerged autonomously or ... been made specially" (85), innovation concerns using inventions to do "things differently in the realm of economic life" (84). He writes, "the making of inventions and the carrying out of the corresponding innovations are, economically and sociologically, two entirely different things" (85). Invention is an input used to facilitate processes of innovation. The analogy that Schumpeter's distinction between innovation and invention enables can be construed as follows: a document is to invention as relevance is to innovation. In use, a document is relevant. In use, an invention facilitates innovation.

This analogy is productive because it also helps to clarify the relationship between relevance and creativity in processes formulated at different scales and in different contexts. In these terms, Newton's personal insight concerning universal gravity was an invention that "emerged" through a creative process that made use of what was afforded by the apple. Just how a theory of gravity emerged, "autonomously" or perhaps as something made "specially," is not

clear. But Newton's statements to his biographer makes clear that the apple was relevant. As Newton and others began to use his theory, it became an innovation that enabled "a doing things differently" in the realms of science and, of course, "economic life."

## 5 Analysis

The notion of relevance and how it is related to creativity can be made clearer by enumerating stages in the process.

### 5.1 From document to affordance

A document is commonly said to be relevant to a need, but this is a simplification. Any document has endless physical attributes and unlimited cultural associations, more than anyone can know and far too many to enumerate. It is implausible that all such aspects of a document would be relevant to any need. Rather, it would be some particular aspect, feature, or attribute of the document, rather than the totality of the document and its attributes, that is perceived to be potentially useful, hence potentially relevant. For Newton it was likely to have been the perpendicular downward trajectory of the apple that was relevant, rather than, say, its color or taste. Any other falling object could have been equally relevant but it happened to be that particular apple's movement that he noticed and used when developing his theory.

Here the concept of "affordance" is useful. It is attributed to James J. Gibson who discussed it in 1979, but the idea is older and appeared notably in the work of biologist Jakob von Uexküll (1934/2010). An affordance is a feature of an environment that has consequences that may be perceived as relating to a purpose. A cave affords shelter, for example. "An affordance is neither an objective property nor a subjective property, or it is perhaps both if you like. ... What we perceive when we look at objects are their affordances not their qualities" (Gibson, 1979, p. 138). Thus, what a document is perceived to afford in use will be predictive of its use and, by extension, of its relevance even if documents themselves or what they afford cannot be called relevant.

### 5.2 From affordance to use

To perceive what is afforded by a document is not necessarily to make use of its various affordances. Use and utilization suggest interactions beyond those that formulate perceived affordances. An affordance is utilized, employed, or applied while in pursuit of some end. The end pursued may be changeable and difficult to ascertain, even if, after the fact, it might be identified. Similarly, how, precisely, an affordance is employed may be difficult to know. But a distinction between the constitutive processes of perception and the utilization of what perception affords can be drawn to clarify relevance as a concept. Newton will have perceived apples and the facts of their falling before he made use of them to formulate what we now call his theory of gravitation. We will never know how, exactly, Newton made use of the apple to formulate what we identify post hoc as his theory. Nor can we be certain that, while he made use of the apple, Newton was always in pursuit of gravitation as a theory. He may have initially been in pursuit of his lunch. But, assuming the story of his theory is not entirely apocryphal, we can be certain that he made use of a perception that was afforded to him by the apple while formulating his theory.

### 5.3 A linear model

We arrive, therefore, at a simple linear model of relevance: Document – Affordance – Perception – Use. Document, affordance, perception, and use recommend distinctions but also an interrelation suggested by their shared axis of use. We can, if we wish, extend our line to the left to acknowledge that any given document is formulated, in part, by a distinct context, such as its position in a collection, for example, or social or cultural perspectives. To the right, we can also acknowledge context as it informs use that may lead to distinct perceptions of what is afforded by a document, as well as, of course, to the generation of new documents, contexts, affordances, perceptions, and uses thus:

. . . (distinct Context) – Document – Affordance – Perception – Use – (distinct Context) . . .

This linear model and the proposition that relevance be associated with documents in use helps solve what has been described as an intractable problem in relevance studies, a “battle royal” (Saracevic, 2007, pp. 1925) between “system-centered research” (Yu and Santos, 2012), or what Borlund might call the class of objective relevance, and “human-centered research” (Yu and Santos, 2012), i.e. the class of subjective relevance. It does so by suggesting that systems and humans are interacting on a continuum rather than a plane of contact imagined as a dividing interface between systems and humans that have different strata articulating their depth. Lines, like our model, have no depth. Nor are they directional. Lines are not vectors and our linear model does not assume directionality from right to left or left to right. Indeed, although difficult to represent in the two-dimensional space of a page, our linear model can be positioned in more than the two-dimensional space.

In several ways, our linear model is like previous models of relevance, such as Saracevic’s 2007 “Stratified model of relevance interaction” (Saracevic, 2007). What we call “use” assumes context, situation, cognition, and querying. What we call documents, he calls content, processing, and engineering. There are significant differences, however. Most notably, rather than interactions occurring at a “surface level” through an interface that divides differing strata on “computer” and “user” sides, our model suggests that interactions take place along the entire continuum of the line.

Importantly, our model does not assume that “context” is on one side of an “interface” and not on the other, or that information use is unidirectional from a “computer” side to a “user” side, which we find difficult to conceptualize. What is counted as “content” in Saracevic’s model and made potentially relevant by systems will, of course, be formulated by social and cultural contexts, as our model suggests. Information in our model does not need to be situated by a single vector. Nor does our model need to advocate for one side or the other in debates over which has more potential use or validity, human-centered versus system-center research, such as is pursued by Hjørland (2010) when he writes “The ‘received view’ of relevance in information science is based on a system–user dualism, against which arguments have been put forward in this paper. The distinction between system’s relevance and user’s relevance is considered defunct because relevance is only meaningful in relation to goals and tasks, and machines do not have goals” (pp. 231). It is true that machines do not have goals, but also true that users often do not have goals either, at least as far as can be easily documented and understood as stable phenomena.

Understanding relevance as documents in use in creative processes provides a way to end the “battle royal” by providing an avenue for conducting research that acknowledges the interaction of people and systems along a continuum. Our model also has the benefit of not confusing relevance with assumed cognitive states or the specifics of documentary complexity, while still retaining the ability to leverage descriptions of cognition and documents to make judgements about what has been used or is likely to be, i.e. what has been or is likely to be relevant.

#### *5.4 From need to pursuits*

As described above, the literature on relevance focuses heavily on searchers’ needs and tasks while generally assuming, for simplicity, that relevant documents will fulfill an identified need. This is problematic for a variety of reasons. In addition to assuming that documents themselves are relevant, it assumes that a need can always be identified. Hence, “need” does not appear as part of our model. Sense-making with documents, as poets will relate, can be enjoyable precisely because they do not fulfill an identified need, at least as need might be defined by an information scientist. The process of making sense can be pursued for the pleasure of making, for example. Creativity, the producing of “something original and worthwhile” (Creativity, 2021) can itself be a purposive pursuit. “Worthwhile” corresponds to terms used by researchers, such as “utility,” “beneficial” or “task-appropriate.” The idea of various and variable pursuits is a better way to think about relevance than need. Pursuit suggests that an end is being pursued without the need to consider the results of the pursuit from any particular evaluative perspective or if an activity is initiated to complete a specific task or because of some unconscious need. Document use will produce a new circumstance, which may be judged to be novel and/or useful.

### **6 Some Ramifications: Prior Knowledge and Context**

A narrower definition of relevance like the one we are promoting has several ramifications. Among the most important to consider is how a narrowly defined model of relevance focuses attention on its edges, on the contexts of document use. Prior knowledge is a kind of context which will affect decisions to select and make use of documents. Hence, prior knowledge is fundamental as a point of departure for both relevance and creativity. (On this point and its neglect by researchers see Konrad (2007, p. 508)). Prior knowledge is not a static cognitive state. Knowing and knowledge change continually and are sensitive to shifts in other kinds of context. Changes in context shift relationships among known things. Newton will have known apples and that they fall from trees. He also knew various theories about moving bodies, but presumably he had not previously considered apples in relation to moving bodies or, vice versa, moving bodies in relation to apples. In this sense, contexts are generative of new relationships among known and unknown things, as well as processes.

#### *6.1 Contexts as generative*

Creative processes and what is used to constitute them are contingent and situational (de Fremery & Buckland, 2022a, b). Contexts, whether we understand these as intellectual, emotional, physical, or in some other way, themselves have affordances that can be used and, in use, become relevant. The musician David Byrne (2012) suggests as much when he writes that “context largely determines what is written, painted, sculpted, sung, or performed” (13). This

was for him “an extremely slow-dawning insight about creation” that opposes conventional wisdom about creativity in which creativity is understood romantically as the “upwelling of passion or feeling” produced by a singer or poet (p. 13). “Opportunity and availability are often the mother of invention,” Byrne adds (p. 14). Byrne’s argument is that contexts shape both possibilities and pursuits. Simply stated, individuals make creative use as best they can of whatever resources are available to them. Our narrow reformulation of relevance helps because it focuses attention on contexts and how they are created by information services, including how the field’s many different relevance measures produce contexts. Like the contexts generated by a small, cluttered club room or a large, well-organized concert hall with fine acoustics, information contexts derived by information services that incorporate theories and measures of relevance influence creative processes and outcomes by making documents and their affordances differently available for use.

### *6.2 Coproduction and its consequences*

Bibliography and search systems are traditionally seen as retrieving documents, but the art of providing information services can also be understood as the generation of contexts in which finding desirable documents becomes feasible. To retrieve a small subset from a large corpus is to move the proverbial needle in a haystack to a pin cushion where it is immediately and conveniently findable. Here “retrieval” is a matter of creating a radically different context for selection. In this sense, bibliographies and information retrieval systems can be understood as context-generating systems.

Historical studies of the use of documents can helpfully predict which documents are likely to be used (i.e. become relevant) in the future, just as established terminology is used in future searches. If, for example, a particular webpage has been used by many people and is thus recommended at the top of a list of potentially relevant webpages, then this convenient accessibility generates a context that makes the webpage more likely to be used than websites further down the list of results. If and when the leading webpage link is used, it may become relevant to the creative process in which it is used, thus shaping whatever creative outcome is produced through its use. The essential point is that search systems and predictions about relevance, whether or not they are made based on historical usage, user needs, or other criteria, coproduce the contexts provided by information services systems. They thus affect the kinds of creative outcomes produced when a system is utilized.

The tyranny of past use as a measure of relevance will ensure that anyone interacting with an information system will be more likely to use the documents already used by others, suggesting a bias towards obsolescence. This will be true even if they afford less for the ends pursued by patrons. Documents conveniently at hand are more likely to be used and (and thus become relevant) even if the results of using them, i.e. some creative outcome, are less than optimal. Relevance premised on experts’ judgements, topicality, lexical similarity, beliefs about human motivation and states of mind, or similar formulations used to predict relevance create contexts that produce distinct affordances to patrons as they pursue their diversity of ends. A narrow, linear model of relevance as documents in use can help to reveal the ways that theories of relevance contribute to the contexts generated by information systems, how these contexts might be inviting and productive of novel utility; and also how they might be alien, alienating, and counterproductive.

## 7 Summary and Conclusions

As Patrick Wilson (1973) notes, relevance is not “a single notion, but many. Or rather, relevance is a highly general and vague notion that can be made specific and precise in a large number of ways” (457). We have proposed a specific and precise formulation of relevance whereby relevance is a function of use in creative processes. Corollaries of this reformulation include the idea that relevance and creativity are interrelated, that documents and their affordances *themselves* (absent perceptions) cannot be relevant even if they can affect what becomes relevant, that relevance is transient, and that relevance is distinct from what might be relevant and what has been relevant.

We have shown that this reformulation of relevance and its corollaries bring improved conceptual and terminological clarity to the discourse about relevance by showing that the referents for relevance in the literature are proxies for relevance that do not distinguish between what might be relevant in the future and what has been judged to be relevant in the past. The “cornucopian” (Saracevic, 2007) and conceptually chaotic ways that relevance has been considered and measured as “system or algorithmic relevance,” “topical or subject relevance,” “cognitive relevance or pertinence,” “situational relevance or utility,” and “affective relevance” (Saracevic, 2007, p. 1931) are organized by our model, allowing for each to be understood as means of predicting and judging relevance. Our model is distinct because it suggests the outcomes of descriptive scientific practices that utilized these conceptions and measures are considered differing kinds of relevance predictions and relevance judgements, each with strengths and weaknesses, rather than descriptions of a phenomenon called relevance. Our model facilitates this by assuming relevance to be a state of things being in use rather than a specific phenomenon or constellation of phenomena. In addition to conceptual simplicity, this model holds out the promise of ending long standing battles in the field by recognizing that there is no need to fight.

Finally, we present some of the stakes involved in how relevance is articulated by suggesting that the ways that relevance is articulated in information systems can affect how users are able to make use of the contexts provided by information systems and, by extension, how information systems can facilitate or disable the co-production of creative outcomes. In other words, like Patrick Wilson’s situational relevance, our model of relevance provides a tool for considering what we might desire from an information system but, unlike Wilson, we do not rely on distinctions between logic and psychology or any conceptual relationship between queries and answers. Our formulation also enables information scientists to more seriously consider creativity and creativity scholars to more seriously consider relevance, which is to say it provides the opportunity to relate relevance and creativity.

## References

- Arafat, S. and Ashoori, E. (2019), *Search Foundations: Toward a Science of Technology-Mediated Experience*, MIT Press, Cambridge, MA and London, UK.
- Bean, C. A. and Green, R. (2001), “Relevance relationships”, Bean, C. A. and Green, R. (Eds.) *Relationships in the Organization of Knowledge*, Kluwer Academic Publishers, Dordrecht, NL.
- Borlund, P. (2003), “The concept of relevance in IR”, *Journal of the American Society for Information Science and Technology*, Vol. 54 No. 10, pp. 913-925.



- Buckland, M. K. (2017), "Document theory", Hjørland, B (Ed.), *ISKO Encyclopedia of Knowledge Organization*, available at: <http://www.isko.org/cyclo/document>, DOI:10.5771/0943-7444-2018-5-425 (accessed 10 April 2022).
- Budd, J.M. (2001). *Knowledge and knowing in Library and Information Science: A Philosophical Framework*, Scarecrow Press, Lanham, MD.
- Byrne, D. (2012), *How Music Works*, Three Rivers Press, New York, NY.
- Cooper, W. S. (1973), "On selecting a measure of retrieval effectiveness", *American Society for Information Science and Technology*, Vol. 24 No. 2, pp. 87-100.
- Cosijn, E. (2018), "Relevance judgments and measurements", McDonald J.D. and Levine-Clark, M. (Eds.), *Encyclopedia of Library and Information Sciences*, 4th ed., CRC Press, Boca Raton, FL, pp. 3940-3947.
- de Fremery, W. & Buckland, M. K. (2022a), "Copy theory", *Journal of the Association for Information Science and Technology*, Vol. 73 No. 3, pp. 407-418. <https://doi.org/10.1002/asi.24558418>. Also <https://escholarship.org/uc/item/6vf642mz>
- de Fremery, W. & Buckland, M. K. (2022b), "Context, relevance and labor", *Journal of the Association for Information Science and Technology*, Vol. 73 No. 9, pp 1268-1278, <https://doi.org/10.1002/asi.24558>
- Ellis, D. (1984), "Theory and explanation in information retrieval research", *Journal of Information Science* Vol. 8, No. 1, pp. 25-38.
- Feist, J. G., Reiter-Palmon, R. & Kaufman, J. C. (2017), "Introduction: The personal side of creativity: Individual differences and the creative process", Feist, G., Reiter-Palmon, R., and Kaufman, J. (Eds.), *The Cambridge Handbook of Creativity and Personality Research*, Cambridge University Press, New York, NY, pp. 1-6, doi:10.1017/9781316228036
- Froehlich, T. J. (1994), "Relevance reconsidered—toward an agenda for the 21st century: Introduction to special topic issue on relevance research", *Journal of the American Society for Information Science*, Vol. 45 No. 3, pp. 124-34.
- Gibson, J. J. (1979), *The Ecological Approach to Visual Perception*, Houghton Mifflin Harcourt, Boston, MA.
- Harter, S. P. (1992), "Psychological relevance and information science", *Journal of the American Society for Information Science*, Vol. 43 No. 9, pp. 602-615.
- Hjørland, B. (2010), "The foundation of the concept of relevance", *Journal of the American Society for Information Science and Technology*, Vol. 61 No 2, pp. 217-237.
- Hjørland, B & Sejer Christensen, F. (2002), "Work tasks and socio-cognitive relevance: a specific example. *Journal of the American Society for Information Science and Technology*, Vol. 53 No. 11, pp. 960-965.
- Kaufman, J. C. & Glăveanu, V. P. (2019), "A review of creativity theories: What questions are we trying to answer?", Kaufman, J. C. and Glăveanu, V.P. (Eds.), *The Cambridge Handbook of Creativity*, 2nd ed., Cambridge University Press, New York, NY, pp. 27-43.
- Kaufman, J. C. & Sternberg, R. J. (Eds.) (2010), *The Cambridge Handbook of Creativity*, Cambridge University Press, New York, NY.
- Kaufman, J. C. & Sternberg, R. J. (Eds.) (2019), *The Cambridge Handbook of Creativity*, 2nd ed., Cambridge University Press, New York, NY.
- Keesing, R. G. (1998), "The history of Newton's apple tree", *Contemporary Physics*, Vol. 39 No. 5, pp. 377-391.
- Kejriwal, M., Knoblock C. A., & Szekely, P. (2021) *Knowledge graphs*. MIT Press.
- Konrad, A. (2007), "On inquiry: Human concept formation and construction of meaning through library and information science intermediation", PhD dissertation, University of

- California, Berkeley, available at:  
<http://www.ischool.berkeley.edu/research/publications/2007/konrad/dissertation>
- Kozbelt, A., Beghetto, R. A. & Runco, M. A. (2010), "Theories of creativity", Kaufman, J. C. and Sternberg, R. J. (Eds.), *The Cambridge Handbook of Creativity*, Cambridge University Press, New York, NY, pp. 20-47.
- Lesk, M. & Salton, G. (1968), "Relevance assessments and retrieval system evaluation", *Information Storage and Retrieval*, Vol. 4 No. 4, pp. 343-59.
- McDonald, J. D. & M. Levine-Clark (Eds.) (2018), *Encyclopedia of library and information sciences*. 4th ed., CRC Press, Boca Raton, FL.
- Mizzaro, S. (1997), "Relevance: The whole history", *Journal of the American Society for Information Science*, Vol. 48 No. 10, pp. 810-32. Reprinted in Hahn, T. B. & Buckland, M. (Eds.) (1998), *Historical Studies in Information Science*, Information Today, Medford, NJ, pp. 221-244.
- Oxford English Dictionary Online*, available at: <https://www.oed.com/>
- Robertson, S.E. and Hancock-Beaulieu, M. M. (1992), "On the evaluation of IR systems", *Information Processing and Management*, Vol. 28 No. 4, pp. 457-466.
- Saracevic, T. (1975), "Relevance: A review and a framework", *Journal of the American Society for Information Science*, Vol. 26 No. 6, pp. 321-343.
- Saracevic, T. (2007), "Relevance: A review of the literature and a framework for thinking on the notion in information science. Part II: Nature and manifestations of relevance", *Journal of the American Society for Information Science and Technology*, Vol. 58 No. 13, pp. 1915-1933; "Part III: Behavior and effects of relevance," *Journal of the American Society for Information Science and Technology*, Vol. 58 No. 13, pp. 2126–2144.
- Schamber, L. (1994), "Relevance and information behavior", *Annual Review of Information Science and Technology*, Vol. 29, pp. 3-48.
- Schumpeter, J. A. (1939), *Business Cycles: A Theoretical, Historical, and Statistical Analysis of the Capitalist Process*, New York, London: McGraw-Hill Book Company, Inc.
- Shiu, E., (Ed.) (2014), *Creativity Research: An Inter-Disciplinary and Multi-Disciplinary Research Handbook*, Routledge, New York, NY.
- Smith, S., Ward, T. B., & Finke, R. A. (Eds.) (1995), *The Creative Cognition Approach*, MIT Press, Cambridge, MA.
- Sperber, D. and & Wilson, D. (1986, 1995), *Relevance: Communication and Cognition*, Second Edition, Blackwell, Oxford UK & Cambridge USA.
- Strassheim, J. (2010), "Relevance theories of communication: Alfred Schutz in dialogue with Sperber and Wilson", *Journal of Pragmatics*, Vol. 42, pp. 1412-1441.
- Stukeley, W. (1752/1936), *Memoirs of Sir Isaac Newton's Life*, Taylor and Francis, London, UK.
- Swanson, D.R. (1986), "Subjective versus objective relevance in bibliographic retrieval systems", *Library Quarterly*, Vol. 56 No. 4, pp. 389-398.
- Taylor, R.S. (1968), "Question-negotiation and information seeking in libraries", *College and Research Libraries*, Vol. 29 No. 3, pp. 178-194.
- Uexküll, J. von. (1934/2010), *A Foray into the Worlds of Animals and Humans*, University of Minnesota Press, Minneapolis, MN and London, UK.
- Ward, T. B. & Kolomyts, Y. (2010), "Cognition and creativity", Kaufman, J. C. and Sternberg, R. J. (Eds.), *The Cambridge Handbook of Creativity*, Cambridge University Press, New York, NY, pp. 93-112.

- de Fremery and Buckland. Relevance and Creativity—A Linear Model. *JDoc* 80, no 4: 882-897. 18
- Warner, J. (2021), *Copyright, Data and Creativity in the Digital Age: A Journey Through Feist*. Routledge, London, UK and New York, NY.
- Weisberg, R. W. (1993), *Creativity: Beyond the Myth of Genius*, W.H. Freeman, New York, NY.
- White, H. D. (2007), “Combining bibliometrics, information retrieval, and relevance theory”, *Journal of the American Society for Information Science and Technology*, Vol. 58 No. 4, pp. 536-559 & 583-605.
- White, H. D. (2018), “Relevance in theory”, McDonald J.D. and Levine-Clark, M. (Eds.), *Encyclopedia of Library and Information Sciences*, 4th ed., CRC Press, Boca Raton, FL, pp. 3926-39.
- Wilson, P. (1973), “Situational relevance”, *Information Storage and Retrieval*, Vol 9 No. 8, pp. 457-469.
- Wikipedia (2021), “Creativity”, available at: <https://en.wikipedia.org/wiki/Creativity> (accessed 7 June 2021).
- Yu, Fei & Santos, E. (2012), “Revisiting concepts of topicality and novelty: A new simple graph model that rewards and penalizes based on semantic links”, in *2012 IEEE International Conference on Systems, Man, and Cybernetics October 14-17, 2012, Seoul, Korea*, pp. 2656-2663.