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# Dimensions of relevance

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**Abstract**

Relevance has become a major area of research in the field of Information Retrieval, despite the fact that the concept *relevance* is not well understood. This paper models manifestations of relevance within a system of relevance attributes to show that the attributes function in different dimensions for the different manifestations of relevance. It is shown that motivational relevance, as a manifestation of relevance, should not be viewed as part of a linear, objective–subjective scale of relevances, but rather as an attribute of relevance. Similarly, that the manifestation of affective relevance should not be viewed as a discrete category of relevance manifestation, but rather as an influencing factor on the other subjective relevance types. The paper argues a consolidated model of relevance manifestations which includes the notion of socio-cognitive relevance. 

*Keywords:* Information retrieval; Relevance manifestations; Relevance attributes; Socio-cognitive relevance; Situational relevance; Topicality; Algorithmic relevance; Performance evaluation

## 1. Introduction

"*Nobody has to explain to users of IR systems what relevance is, even if they struggle (sometimes in vain) to find relevant stuff. People understand relevance intuitively*" (Saracevic, 1996, p. 215).

Nevertheless, relevance has become a major area of study in information science. In the past, studies have concentrated either on a systems-centred or a user-centred approach to Information Retrieval (IR). However, recent studies on relevance view IR as a cognitive

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interaction between human and computer. Furthermore, there are many kinds of relevance, not one only (Mizzaro, 1997).

In a recent article, Saracevic (1996, p. 216) developed an interactive framework which offers an integrated model to incorporate a system of relevance, and states that "The effectiveness of IR depends on the effectiveness of the interplay and adaptation of various relevance manifestations, organized in a system of relevances. Thus the major direction of R&D in information science should be toward increasing the effectiveness of relevance inter-plays and interactions. This should be the whole point of relevance research in information science."

Saracevic further argues that relevance manifests itself on different levels or strata. Relevance inferences may differ at various levels, but the inferences are always interdependent, and IR evaluation is all about comparing relevance inferences from different levels. Relevance can be typified at different levels of manifestation, and we can study its behaviour and effects within and between strata (Saracevic, 1996). Briefly stated, Saracevic's relevance system contains the following relevance manifestations: algorithmic; topical; cognitive relevance or pertinence; situational; and motivational or affective relevance. A tabular version of Saracevic's model is displayed below (Table 2).

Relevance has certain attributes, and relevance manifests itself in different ways. In this paper we will examine one of the possible ways to model relevance *manifestations* (as defined by Saracevic) within a system of relevance *attributes*. The manifestations of relevance are plotted against attributes of relevance that show that the attributes function in different dimensions for the different manifestations of relevance. This gives rise to the first issue to be discussed in this paper: should the defined manifestation of *affective or motivational relevance* be regarded as part of a linear scale of moving from objective to subjective relevance? One may argue that motivational relevance is the same as the *intent attribute*. Further, one might suggest to replace it by a *socio-cognitive relevance* as the ultimate manifestation of relevance on a linear scale, as proposed by ørom (2000) under the label of contextual relevance, and corresponding to domain-related relevance (Hjørland, 1997).

Secondly, one may regard affective relevance as a dimension of relevance influencing *all* the preceding subjective relevance types. We will argue that affective relevance is not a discrete category or part of a linear scale. It should rather be viewed as part of, and influencing the subjective types of relevance (topical, cognitive, situational and socio-cognitive relevance).

The structure of the paper is as follows: Section 2 presents an introduction to the nature of relevance by describing the different aspects of the attributes and manifestations of relevance. Section 3 consists of a matrix where the attributes of relevance are plotted against the manifestations of relevance. This section will also include a discussion of emerging patterns in the matrix, and will be done through examining each of the attributes of relevance in turn. Then follows a discussion on the concepts of affective, motivational and socio-cognitive relevance and our proposal of a consolidated model of relevance manifestations. The concluding section contains the findings and a summary of the major points presented in this paper.

## 2. The nature of relevance

A wide variety of subject fields have tried to deal with the concept of relevance. Theoretical frameworks abound, and yet, relevance is also a concept that is intuitively understood, but very difficult to define. Nevertheless, since information science was first seen as a distinct discipline in the 1940s, relevance has been identified as its fundamental and central concept (Schamber, Eisenberg & Nilan, 1990).

The meaning of relevance has changed tremendously since the time Vannevar Bush published "As we may think" in 1945. He proposed a very simplistic systems approach to bring some order to the "bewildering array of knowledge" that suddenly flooded human understanding after W.W. II, and indeed, in the 1960s when relevance had become a major research topic, the systems approach was the one adhered to (Saracevic, 1975).

On the other side of the spectrum, and taking into account contributions of other subject areas on the study of relevance, Syracuse University (Schamber et al., 1990) undertook research on the matter in the 1980s. They developed a theory of relevance that was very user-oriented, and defined as a dynamic exchange of information and communication that depends on the quality of the relationship between information and information needs of the user.

Simply put, in accordance with the cognitive model for interactive IR as proposed by Ingwersen (1996, p. 9), IR comprises three elements or role players — systems, users, and the environment. The system involves documents or information objects (which might be represented in various ways), which are then organized in a file and, through a given algorithm, prepared for matching a query via an interface mechanism. The user typically has a problem or a work task to perform and a derived information need which has to be apparent to a certain degree to the user. For example, it might be verbalized before it can be transformed into a query which is acceptable to the system algorithm. The socio-organizational environment provides the context or situational framework *influencing* the activities of the user. In systems approaches to IR, relevance is considered to be a property of the system, whereas in user-oriented and cognitive approaches to IR, relevance has to do with the cognitive processes of the users and their changing knowledge and needs regarding information, stimulated by the context (Ingwersen & Borlund, 1996).

It is clear that the concept of relevance covers a very wide area of knowledge, and it is perhaps owing to this diversity that the latest studies concentrate on the interaction between the user and the system in trying to establish what relevance really is. It is during this interaction that an important new dimension must be added, namely that of *time* (Mizzaro, 1998). This time dimension can be measured and plotted in terms of *information-seeking* stages and successive searches (Spink, Greisdorf & Bateman, 1998; Wang, 1997), and will play an important role in the discussion to follow.

### *2.1. Attributes of relevance*

In his article of 1996, Saracevic sources from intuition, philosophy and communication, and ascribes the following attributes to relevance, starting from the assumption that relevance is rooted in human cognition (Table 1).

This is neatly summarized by the following words: "As a cognitive notion relevance involves

Table 1
Attributes of relevance (Saracevic, 1996)

| | Attributes of relevance |
|---|---|
| *Relation* | Relevance always implies a relation, often in communication or exchange |
| *Intention* | The relation in expression of relevance involves intentions such as objectives, roles, expectations (motivation) |
| *Context* | Intention always comes from a context, and is always directed toward that context |
| *Inference* | Assessment (often graduated) of the effectiveness of a given relation |
| *Interaction* | Inference is accomplished as a dynamic process of interaction, and interpretations of the other attributes change as cognition changes |

an interactive, dynamic establishment of a relation by inference, with intentions toward a context'' (Saracevic, 1996, p. 206).

### 2.2. Manifestations of relevance

Looking at the attributes of relevance as listed above, it is clear that relevance always indicates a relation. Different manifestations of relevance indicate different relations. It would therefore seem that the trend moves towards viewing relevance in IR not as a single definition of relevance, but as a system of relevances (note the plural). Consequently, no single relevance in the system can be viewed in isolation. Relevance exists as an interacting system of relevances on different levels.

As with studies on the nature of relevance, manifestation studies are also widely divergent. In his article, Saracevic (1996) summarizes these studies and distinguishes the following manifestations of relevance (Table 2[1]).

Although Saracevic does not explicitly mention it, it is interesting to note that the relevances are moving (in the order listed above) from a systems approach to a user- and socially-oriented approach. Thus the whole spectrum is included.

The view that relevance is not any more simply a binary distinction between objective and subjective relevance or consisting of a binary scale, is also supported by other researchers, for instance by Greisdorf and Spink (1999). Borlund and Ingwersen (1998) introduce the concept of relative relevance that describes the degree of agreement between various types of relevance applied in the evaluation of information retrieval systems. By means of an empirical study of relevance assessments by test persons, they show how such types of relevance can be compared quantitatively by graduated assessments.

[1] In all instances the term ***text*** (or information object) is seen to mean not only retrieved texts (objects), but also texts (objects) in the system file or even texts (objects) which are in existence somewhere, but not necessarily in the system file (Saracevic, 1996).

## 3. Attributes and manifestations of relevance: What are the connections?

In this section we will first plot the manifestations of relevance against the attributes of relevance (both as defined by Saracevic, 1996), and then we will discuss in some detail the content of each of the cells in the matrix (Table 3). The discussion will be done according to the attributes of relevance. The last column in the table is shaded, as the question regarding the inclusion of these types of relevance will be discussed in Section 4 of this paper.

### 3.1. Relation

Relevance always implies a *relation*. In Saracevic's scheme (1996, p. 214), this relation is between some entity and the information object, which is simply defined as "texts". We should like to argue that information objects should be defined much broader to include anything conveying information, including, for example, images. The implications of this broader definition will be discussed in more detail under Section 3.5, where the time dimension has a certain impact on the interaction process. From the table above it is clear that the relevance attribute *relation* moves from being purely objective (between the query and the system) to a highly subjective and individualised relation that involves the user's intents, goals and motivations. Each of these relations will now be discussed in more detail.

The relation defining *algorithmic* (or system) *relevance* may be measured in terms of the comparative effectiveness of logical and/or statistical similarity of features inferring relevance. This relation is very much system-oriented because the success of the relation is entirely dependent on a given procedure or algorithm, and the intent behind it. Both the query and the

Table 2
Manifestations of relevance. Derived from Saracevic (1996)

| Manifestations of relevance | | |
|---|---|---|
| Relevance | Describes a *relation* between | Criterion for "success" |
| System/ *algorithmic* relevance | Query *and* information objects (texts) | Comparative effectiveness in inferring relevance |
| *Topical* relevance | Subject or topic expressed in a query *and* subject or topic covered by information objects | Aboutness |
| *Cognitive* relevance/ *pertinence* | State of knowledge and cognitive information need of the users *and* information objects | Cognitive correspondence, informativeness, novelty, information quality |
| *Situational* relevance/ *utility* | Situation, task or problem at hand *and* information objects | Usefulness in decision-making, appropriateness of information in problem resolution, reduction of uncertainty |
| *Motivational*/ *affective* relevance | Intents, goals and motivations of the user *and* information objects | Satisfaction, success, accomplishment |

Table 3
Attributes and manifestations of relevance

| Attributes of relevance | Manifestations of relevance | | | | |
|---|---|---|---|---|---|
| | System/algorithmic | Topical/subject | Cognitive/pertinence | Situational/utility | Motivational/affective |
| Relation (see also Table 2) | Query ⇒ Information objects (feature-based) | Subject/topic expressed in query ⇒ Information objects | State of knowledge/ cognitive information need ⇒ Information objects | Situation, task or problem at hand as perceived ⇒ Information objects | Intents, goals, motivation of user ⇒ Information objects |
| Intention | (a) System dependent. (b) Intent behind algorithm | (a) User/assessor expectations. (b) Intent behind query | Highly personal and subjective, related to information need | Highly personal and subjective, related to work task | Highly personal, subjective or even emotional |
| Context | Tuning search engine performance (e.g. TREC) | All types of subjective relevances are, by definition context-dependent (user's or assessor's context) | | | |
| Inference | Weighting and ranking functions | Interpretation | Subjective and individualised process of interpretation, selection and filtering | User's ability to utilise information objects in a meaningful way | |
| Interaction | Automatic relevance feedback or query modification | Relevance judgements are time dependent | Time dependent to a very large extent | Including interaction with socio-organisational domain | Highly individualised |

objects contain identical/similar *features*, such as words and other strings of signs, image colour or author name.

*Topical* (or subject) *relevance*, often also named ''topicality'', is characterised by a relation between the topic of the query and the topic of the assessed information objects. It may be measured in terms of the aboutness of the information objects and queries. This relation is system-oriented to a large extent because the success of the relation depends on the system's input policy, as well as its indexing and searching ability to retrieve relevant objects. However, success also depends on the formulation of the request by the user, transformed into a query by the system. The assumption is thus that both requests/queries and objects may be interpreted by a *cognitive agent*, for instance an assessor, a user or an intermediary, as being about the same or similar topic(s). There exists thus a degree of subjectivity on the user side that is reinforced if human indexing/knowledge organisation is applied to the system. A different example of topicality is found during a peer reviewing process for a conference. One central criteria in the review process is whether a paper is on the conference topic(s) or not.

*Pertinence* (or cognitive relevance) is measured in terms of a relation between the state of knowledge, or the cognitive information need of the user, and the information objects as interpreted by that user. Cognitive correspondence, informativeness, novelty, information preferences and adequacy of form, authorship and the like are the criteria by which cognitive relevance is inferred. This relation encompasses both system and user, because the success of the relation depends on the system's indexing and searching ability to retrieve relevant information objects. However, success also depends on the formulation of the request (query) by the user. In this case, the user's ability to formulate a request is dependent on his IR and conceptual knowledge background and his understanding or perception of his information need (Ingwersen, 1992). Hence, in the case of an intrinsically ill-defined information need at a given point in time, the user may be unable to assess pertinence. Obviously, even if an information need is intrinsically and verbally well-defined, assessors (or other observers) may have difficulty in providing pertinence assessments. Pertinence seems to be moving towards a user-oriented relevance and away from a system-oriented relevance.

This type of relevance is described extensively by Barry (1994). She undertook an empirical study to define the criteria mentioned by users' evaluation of the information within documents as it related to the users' information-need situations. The results showed that the criteria employed by the users included tangible (form or feature) characteristics of documents, as well as subjective qualities together with affective and situational factors.

In relation to a paper reviewing process, a typical criterion is the degree of novelty of the research presented by the paper. A paper may be topically relevant but repeating earlier results.

*Situational relevance* (or utility) is measured in terms of the relation between the *perceived* situation, task or problem at hand and the usefulness of information objects as perceived by the user. Usefulness in decision-making, appropriateness of information in problem solving, and reducing uncertainty are criteria by which situational relevance is inferred. This relation encompasses both system and user, because the success of the relation depends on the system's indexing and searching ability to retrieve relevant objects. However, it also depends largely on the user's ability to *use* the information objects for a certain purpose within a given situation or context. The situational relevance seems to be moving towards the interaction between the

environment or domain, i.e. the situation, and the individual user. An example could be that the user takes part in a peer reviewing process in which he assesses the usefulness and impact of works of applicants to a faculty position. To assess the appropriateness of the contributions, the reviewer takes into account the topicality and preferences assigned the position, being influenced by the community culture of the department and the scientific domain. Another instance is the distribution of citations in a scientific article and on its reference list. The citing author(s) will be influenced heavily by the results to be conveyed but also by personal and affective attitudes as well as what is allowed (the tradition) in that particular domain (Cronin, 1984). The citations represent the intellectual/affective balance of the individual interpretation in time and domain understanding. The distinction between pertinence and situational relevance is difficult to establish by an observer since the observed context and situation, that frame the user's work task, also influence her cognitive state and information need perception unknown to the observer. However, the user herself may well be capable of this distinction if she can separate between novelty or preferences (pertinence) of the required information and its usefulness to fulfil the underlying work task or problem situation.

Covering the same areas of relevance as the manifestations of topical, cognitive and situational relevance as defined by Saracevic, a comprehensive relevance model was also proposed by Mizzaro (1998). He defines relevance as a four-dimensional relationship between an *information resource* (surrogate, document, and information) and a *representation of the user's problem* (query, request, real information need and perceived information need). This is then judged according to one or more of the following *components*: topic, task, or context, at a particular *point in time*. The three components of topic, task and context have subsequently been used by Reid (1999) to define an "ultimate task relevance", to which should be added "information value" in order to include the broader social context of a task-oriented paradigm. This definition of task relevance may, however, be seen as too limiting, as it only accounts for the *search task* performer's point of view (Reid, 1999, p. 106) and not to the *work task* as perceived by the actor. We may also observe that algorithmic relevance is absent and that task and contextual relevance touch upon some, but not all, of the characteristics of situational relevance. One may also note that Mizzaro's dimension of information resource assumes that *information* resides *in* documents and not as a result of cognitive processes of interaction between resource and cognitive agent. However, the same dimension points to the distinction between *bibliographic relevance*, i.e. assessments based on surrogates, and *document relevance* in which the assessments are based on the observation of the entire information object.

Following Saracevic (1996), the relation describing *motivational or affective relevance* is the relation between the intents, goals and motivations of the user and the information objects. Satisfaction, success, accomplishment and the like are the criteria by which affective relevance is inferred.

This relation encompasses both system and user, because the success of the relation depends heavily on the system's inclusion policy for texts, its indexing ability and the ability to retrieve relevant texts. However, success mostly depends on the *manner* in which the user *applies* the information retrieved. In the case of motivational relevance especially, it is the user (or group of actors) who is directly responsible for the utilisation. However, the broader community, the context, in which the user operates is also involved in the measurement of the success of the relation. More than any other manifestation of relevance, Saracevic's *motivational relevance* is

human- and socially oriented as opposed to system-orientated. In accordance with Searle's (1984) generalised conceptualisation of *intentionality* the motivational manifestation can more clearly be seen as the same as Saracevic's attribute of *intent*. This issue will be discussed in more detail in Section 4.1.

Further, one might thus suggest to replace it by the notion of *socio-cognitive relevance*, owing to its social and cultural properties. Socio-cognitive relevance is measured in terms of the relation between the situation, work task or problem at hand in a given socio-cultural context and the information objects, as perceived by one or several cognitive agents. It encompasses the system, a group of individual users or agents, and the socio-organisational environment. The final result of a peer review process, for instance, in the form of the final ranking of information objects submitted to a conference or candidates agreed upon by *all* the reviewers, and its underlying reasons, are examples of this type of relevance. ørom (2000) exemplifies this manifestation by analysing how different cultural factors affect the assessments of relevance in libraries. The *time issue* plays a crucial role in this relevance category, as demonstrated empirically in longitudinal information-seeking studies by Wang (1997) and Wang and White (1999). It is interesting to note that some central aspects of socio-cognitive relevance are tangible. For instance, when informetricians carry out author co-citation mappings of domains for a given period of time, they make statistical use of the cognitive authorities defined by the citations received in that domain. The resulting socio-cognitive mapping is thus direct evidence of this kind of relevance. Other aspects are not tangible and are inherent to the actors themselves; for instance, their underlying reasons, emotions and intent.

In addition, one may argue that *affective relevance,* in particular, may play a crucial role connected to the *relation* attribute in *all* the subjective types of relevances. Success and satisfaction are dimensions of relevance that can easily be found to be associated with topical relevance or pertinence as, for instance, empirically demonstrated by Barry (1994). As mentioned above, one may observe affective relevance in relation to situational relevance to form part of the considerations behind the inclusion of items on a reference list.

### 3.2. Intention

Saracevic defines intention as follows: "The relation in expression of relevance involves intention(s) — objectives, roles, expectations. *Motivation* is involved" (1996, p. 206). These intentions are always derived from a context, personalised, and are directed towards that context (see Section 3.3 below). For each of the manifestations of relevance, the intention attribute will be discussed in more detail.

*Algorithmic relevance* is very much system dependent, and if the relation is described as that between features of the query and the information objects, then intention is *not* relevant. One could make a case, however, that the intent *behind* the retrieval algorithm might be regarded as an intent towards an objective, in which case the attribute of intention is relevant in system relevance.

In *topical relevance* the relation is between the subject of the query and the subject of the text, which makes intention an important attribute of topical relevance. The objectives, roles and expectations of the user as well as the motivation behind the query (intention) will

influence the relevance of the objects to the user. An interesting distinction is the intentions (or lack thereof) of users and assessors. Each individual user has intentions, but an assessor (for example, in TREC experiments) *per se* possesses a different intention and will, therefore, judge objects differently from actual users and among themselves (Voorhees, 1998).

Intention in relation to *pertinence* is highly personal and subjective. It is very strongly related to the information need in cognitive relevance. Assessors (and other non-users) are therefore excluded from this type of relevance because the value of information objects is largely determined by the intentions and motivations, such as objectives, roles, experiences and expectations of the actual user.

Intention in *situational relevance* is determined by the individuals under influence of their work task and previous experiences in context of the environment that, over *time*, may influence the relevance assessments. In *socio-cognitive relevance*, intention signifies the strategy or tactical decisions of a group of people, a network or an organisation.

When one compares the *intention attribute* for the subjective relevances with the original manifestation of *motivational relevance,* it is clear that they are very similar. One may therefore argue that the rationale behind motivational relevance is, in fact, already included in the intention attribute of relevance, and that motivational relevance is not the same as affective relevance. However, affective relevance could be seen as an aspect of the intent attribute in all the manifestations of relevance, namely as the *degree of success* or satisfaction in relation to the actor's expectations. This issue will be discussed in more detail in Section 4.

### 3.3. Context

"The intention in expression of relevance always comes from a context and is directed toward that context — the matter at hand. Relevance cannot be considered without a context" (Saracevic, 1996, p. 206).

For *algorithmic relevance* one may argue as follows: If intention is not relevant, context is not relevant, since intention is always derived from a context. Neither the system nor its algorithms are relevant to the context from which the user directs his query. On the other hand, if one looks at algorithmic relevance from the point of view that there may be an intent behind the algorithm, then experiments conducted in TREC, where search-engine performance is tuned within a context, i.e. the experiment, context may be seen as a relevant attribute.

For *topical, pertinence, situational* and *socio-cognitive relevance*, one might state that all types of subjective relevance are, by definition, context dependent. Situational and socio-cognitive relevance may be seen as the relevance manifestations that depend the most on the context within which the user(s) operate(s), that is, the given task or problem situation stimulated by the environment. In particular for socio-cognitive relevance, a chain of contexts can be assumed to be involved. To a user it may be impossible to be conscious about or to express *which* context that, at a given point in time, actually influences a particular type of relevance. For instance, concerning pertinence, the context might be the given situation and/or an underlying organisational strategy. Hence, the context attribute itself is not sufficient to distinguish between types of relevance.

### 3.4. Inference

Inference is defined as follows: "Relevance involves assessment about a relation, frequently a *graduated assessment* of the effectiveness or degree of maximization of a given relation, such as assessment of some information sought for an intention geared toward a context" (Saracevic, 1996, p. 206).

If inference is the assessment of the effectiveness of the relation between the query and the objects, inference is relevant even in *algorithmic relevance*. Typical examples would be weighting options and ranking functions in full text search engines, based purely on execution of algorithms based on the user's query features and the documents' indexing features.

If inference is seen as the assessment of the effectiveness of the relation between the topic of the query and the topic of the information objects, inference must be relevant *in topical relevance* as well as to *pertinence*. In the former case, inference is represented as an interpretation of the aboutness of objects and the "subject matter at hand" with which the user is dealing. Anybody can infer the aboutness of objects, but due to the underlying intentionality only the actual user may infer the proper *relation*. For pertinence, inference can also be defined as the *interpretation* of the information objects by the user, but now associated with his information need and knowledge gap as perceived. Filtering and selection processes may take place and the interaction (next attribute to be discussed) thus plays a major role in the establishment of the effectiveness of this relation. Like in algorithmic relevance, assessments can be graduated, as done experimentally by Borlund and Ingwersen (1997, 1998) in interactive IR and modelled by Spink et al. (1998).

Inference in *situational* and *socio-cognitive relevance* could be described as the user's ability to utilize objects in a meaningful way (meaningful to the user and/or the environment/domain). Inference in this case is the assessment of the effectiveness of the relation between the user's perceived situation, task or problem at hand, and the information objects. The perception includes the cognitive influence of the context, also through interaction, e.g. in group activity, and the given situation. A typical *difference* between situational and socio-cognitive relevance is that an object may be topically correct, (suiting the personal information need, fitting the individually perceived work task), *but* being unsuitable to the current organisational strategy — or *not fitting*, the task but suiting the strategy. In both cases an object's relevance value is decreasing.

### 3.5. Interaction

Interaction is the dynamic process where interpretations of the other four attributes of relation, intention, context and inference of the relation towards the information objects may *change* as cognition changes (Saracevic, 1996, p. 206).

In general, one could say that for *algorithmic relevance* there is no process of interaction possible between the query and the object, through the system or its algorithms. Interaction is therefore irrelevant. On the other hand, in the case of Human–Computer Interaction, the user's role is solely to provide the input (query versions), and it is possible to look at automatic relevance feedback or query modification as a type of system interaction.

For *topical relevance*, although the aboutness of the texts is a stable and unchanging factor,

the interpretation, information value and therefore relevance may change during this process. The *time* dimension influences the user's decisions. If we look again at the distinction between actual users and assessors (see Section 3.2), it is clear that for assessors, topicality is assumed to be stable. It simply has to be invariant due to the traditional experimental setting applied (Ingwersen, 1996) and assessors commonly judge the final system output as if one iteration of interaction takes place. Assessors, and other non-users, do not have a real work task, and therefore no motivations or expectations according to which the real information value or relevance to the information need can be assessed. One might say that their quite simple work task is alone to assess topical correspondence between objects and queries, in the context of an experiment.

Regarding the aboutness or topicality of objects, we note that being stable, the time dimension has little influence on algorithmic relevance. However, for topical, pertinence, situational and socio-cognitive relevance, *changes in cognition over time* have an increasingly profound influence on the dynamic process of interpretation, and are especially individualised in *affective relevance*.

*Pertinence* is characterised by the novelty, informativeness, preferences, information quality, and so forth of objects, that depend on the user's need at a particular point in *time*. In turn, the user's need changes as his understanding and state of knowledge (cognition) on the subject change during a session as well as over several sessions (Wang, 1997; Wang & White, 1999). Form, features, and presentation of objects have a crucial impact on the assessments.

Interaction in *situational relevance* is the extent to which the individual user utilises the object to his specific purpose in a given situation. The suitability of interaction as an attribute, within the manifestation of situational relevance, is therefore very firm. Implicitly, previous or simultaneous interaction with the socio-organisational environment may influence the inference owing to its contextual power. Interaction in *socio-cognitive* relevance takes typically place *within* the organisational environment or community. In science communities, for instance, final programme committee meetings carry out this activity intensively. Obviously, a link exists to a system-input type of relevance, for instance, as manifested as the actual papers finally accepted for a conference.

To a large extent, this is also in agreement with the following two points summarised by Reid (1999, p. 104). If a user has only topical criteria for relevance assessments, his ideas of relevance are not likely to change substantially over the course of a session. However, in a task context these ideas are likely to change more radically as his focus moves from the concerns of the IR session to the consideration of which information is required to complete his work task. Furthermore, "the post-session task context and broader social context will heavily influence the user's ideas of relevance, so his ideas will continue to be modified after finishing the IR session and even after completing the task." We observe an association to Tague-Sutcliffe's (1995) informativeness measure of objective nature in the form of actually used objects in a task product viewed against the retrieved objects previously judged relevant (informative) for that task, again linking up to a system-input relevance dimension.

In Section 3.1 we argued for a broader definition of information objects than merely "texts". If one should consider other information objects (such as images), it is easy to see that their degree of *semantic openness* is far greater than that of texts. Therefore, if this definition is

broadened, the interaction (especially in the more subjective types of relevance) may change quite dramatically.

## 4. Discussion of the modified relevance model

Affective or motivational relevance is defined as the "relation between the intents, goals, and motivations of a user, and text retrieved by a system ... Satisfaction, success, accomplishment and the like are criteria for inferring motivational relevance" (Saracevic, 1996, p. 214). In Section 3.2 we have argued that *affective relevance* is not the same as *motivational relevance*, and that motivational relevance is already included in the *intention attribute* of relevance. First we will discuss the issue of motivational relevance as intentionality, and then look at affective relevance as another dimension of relevance, influencing all the other subjective types of relevance. In this perspective we will then propose and discuss the modified relevance model, including the manifestation of socio-cognitive relevance, and briefly look into the consequences of the model, for instance in terms of measurability.

### *4.1. Motivational relevance as intentionality*

Information could partly be viewed as something which, "when perceived, affects and transforms the recipient's state of knowledge" (Ingwersen, 1992, p. 33). *Perception*, in turn, relates to *intentionality*, defined by Searle (1984, p. 3) as "that feature of certain mental states and events that consists in their ... being *directed at*, being *about*, being *of*, or *representing* certain other entities and states of affairs".

Searle (1984, pp. 14–15) argues that teleological forms of explanation are those in which a phenomenon is explained in terms of goals, aims, purposes, intentions and similar phenomena. Furthermore, all teleological explanations are merely species of explanation in terms of intentional causation. He operates with two levels of intentionality. The first level may be seen as *intrinsic intentional phenomena*, which are beliefs and visual experiences (states and events) that really exist in the minds of the agents. They are to be taken literally. The second level consists of *derived intentionality*, which is caused by the first level of intentionality. This is in agreement with Saracevic's definition of the intent attribute of relevance.

As motivational relevance also deals with the intents, goals and motivations of the user, one might argue — as done above — that motivational relevance is redundant if defined as a relevance type, as all the elements thereof are already included in the intent attribute.

### *4.2. Affective relevance*

From the table and discussions in Section 3, it is clear that affective relevance is highly individual and personal, and therefore very subjective. In her empirical investigation, Barry (1994, p. 155) observes and defines similar types of relevance labelled by "criteria pertaining to the user's beliefs and preferences". She identifies two categories, namely subjective accuracy/validity and affectiveness. Subjective validity is defined as the extent to which the user agrees with the information within the document or the extent to which the information in the

document supports the user's point of view. Affection refers to emotional responses to any aspect of the document. A very interesting phenomenon is that 15.8% of the relevance statements by users in Barry's study fall within this group (compared to 35.1% on the contents of the documents, and 21.6% on the user's background and experience). Users therefore regard this type of relevance judgement as an important criterion overlapping other criteria in the selection of relevant information objects.

Affective relevance, under various labels, has been studied in the literature for quite some time (Schamber, 1994) and it is clear that it is an important manifestation of relevance. It is not clear, however, why this type of relevance should be classed as a separate category of relevance, or as the ultimate subjective relevance on a scale of relevance. Judging from current literature it seems that the level of influence of affective relevance differs from those of the other subjective relevance types. One might therefore argue that affective relevance acts rather as another dimension, influencing all the previous subjective relevance types.

### *4.3. The modified relevance model*

The revised model of attributes and manifestations of relevance is shown in Table 4. In an IR evaluation perspective the algorithmic and topical relevance types have been applied mainly to the non-Boolean (best match) experiments, whilst topicality and pertinence are predominant in interactive investigations based on Boolean systems. Only recently has situational relevance come into play, also in connection with interactive best match systems evaluation (Borlund & Ingwersen, 1998; Borlund, 2000). Similarly, graduated relevance assessments are still rarely used in interactive IR experiments (Spink et al., 1998).

In Table 4 we have placed affective relevance, not as a manifestation nor as an attribute, but as a dimension in line with time. The latter dimension poses an increasing impact during interaction on the relevance assessments. We regard socio-cognitive relevance as a subjective type of relevance determined by the individual actor in *interaction* with other actors *within a community*. When tangible and measured, it may often exhibit statistically objective characteristics (inter-subjectivity). That is the reason for its application in mapping scientific fields that are reliable, but with a degree of uncertainty. This is also the reason for its obvious link to system-input relevance (not dealt with in this paper). One should bear in mind the absolute distinction between a relevance type and its degree of measurability. If something is tangible it might mean that we have a convenient *operational variable* — for example, citations or accepted papers — but we may not really know the complete association to the underlying *theoretical variable(s)*. For instance, one may find it quite difficult to distinguish experimentally between pertinence and situational relevance: are users capable of distinguishing between the situation causing an information need which, as a knowledge gap, is difficult to express and that information need itself? One possible way of measuring pertinence might be to assess the *learning effect* obtained during a search session; for instance, by observing the semantic changes that take place as the search progresses. This has been done experimentally by Ingwersen (1982) and Chen and Dahr (1990).

Situational relevance is different from the socio-cognitive type in that it is purely subjective. The differences arise particularly in relation to the intention, inference, and interaction attributes. The interesting tangible difference lies exactly in the difference between, for instance,

Table 4
Revised table of attributes and manifestations of relevance

| Attributes of relevance | Manifestations of relevance | | | | |
|---|---|---|---|---|---|
| | | ⇔ Affective relevance ⇔ | | | |
| | Algorithmic | Topical | Cognitive/pertinence | Situational/utility | Socio-cognitive |
| Relation (see also Table 2) | Query ⇒ Information objects (feature-based) | Subject/topic expressed in query ⇒ Information objects | State of knowledge/ cognitive information need ⇒ Information objects | Situation, work task or problem at hand as perceived ⇒ Information objects | Situation, task or problem at hand as perceived in socio-cultural context ⇒ Information objects |
| Intention | (a) System dependent. (b) Intent/motivation behind algorithm | (a) User/assessor expectations. (b) Intent/motivation behind query | Highly personal and subjective, related to information need, intentions and motivations | Highly personal and subjective or even emotional. Related to goals, intentions and motivations | Personal, subjective/ org. strategy. Related to user's experience, traditions, scientific paradigms |
| Context | Tuning search engine performance (e.g. TREC) | All types of subjective relevance are, by definition, context-dependent (user's/assessor's context) | | | |
| Inference | Weighting and ranking functions | Interpretation of aboutness and subject matter at semantic level | Subjective and individualised process of cognitive/pragmatic interpretation, selection and filtering | User's ability to utilise information objects in a way meaningful to user | Users' (or group's) ability to utilise information objects, meaningful to environment |
| Interaction | Automatic relevance feedback or query modification | Relevance judgements are content dependent | Relevance judgements are content, feature, form and presentation dependent | Including interaction *with* environment | Including interaction *within* environment |
| | | Increasing | Time | Dependence | ⇒ |

*single reference lists* (individual recognition of use and interpretation) in scientific papers representing a particular research situation in time, and many such lists broken down into single *citations received by* individual authors, articles, journals, institutions or countries. Analyses of citing publications, represented by their cited works, and cited objects, represented by the citing publications, imply individual or domain-related cognitive authority, signifying situational and socio-cognitive relevance respectively. One might hence argue that if a journal impact factor (JIF) is divided into journal self citation and external citation impact figures (Christensen, Ingwersen & Wormell, 1997), the latter ratio actually represents an estimate of the socio-cognitive relevance of that journal. Socio-cognitive relevance can thus be regarded as a domain-dependent and quality-associated measure, also of the relevance of Internet objects through the link structure to a domain. Other kinds of citation analyses may signify different facets of this manifestation of relevance. We observe how socio-cognitive relevance establishes an obvious bridge between information retrieval and scientometrics.

### *4.4. Some consequences of relevance variety*

Voorhees (1998) demonstrated that statistically there is no difference in the *relative performance* rankings between the systems involved in TREC if, for instance, three assessors versus one are making topicality judgements of retrieved documents, provided that enough queries ($>40$) are run against the systems. The explicit conclusion is obviously that there is no need for several assessors in non-interactive IR experiments – one is enough provided a proper amount of queries are applied. From a broader perspective this is a promising result. It demonstrates that even in completely unrealistic but stable retrieval environments (non-interactive TREC) inter-assessor inconsistency is significant for some individual queries. From a cognitive and performance point of view, such queries should be interesting to analyse further. Secondly, Voorhees' exercise indicates that in realistic, i.e. interactive, IR experiments, one assessor is as good as anybody else, including users as assessors. One might hence apply the classic placebo-like experimental setting with two groups of simulated work tasks to be performed by two groups of test persons confronted with one machine, or applying other combinations of test groups, query/need/work task/situation types, and systems to be compared (Pors, 2000). It is thus realistically possible directly to apply and *compare* the variety of relevance manifestations depicted on Table 4; for instance, as done empirically in relation to algorithmic, topical and situational relevance by means of the relative relevance (RR) measure studied by Borlund and Ingwersen (1998). The relevance scheme can be seen as a tool for characterising more profoundly the individual systems which, in turn, may inform about what to alter in the systems and why.

## 5. Conclusion

By plotting the attributes of relevance against the manifestations of relevance, we have shown that the *attributes* of relevance function in different dimensions for the various *manifestations* of relevance. We have argued that the manifestation of *motivational/affective relevance* should not be viewed as a discrete category or as part of a linear scale of relevances.

Instead, motivational relevance may essentially be included in the attribute of intention, and affective relevance acts as a different dimension altogether, influencing all the other subjective relevance types. Some empirical investigations clearly demonstrate this phenomenon. The analyses revealed the necessity for revising the model of relevance manifestations. The modified model includes a *socio-cognitive* type of relevance that is highly context dependent and associated with organisational strategies or scientific community interaction within. Finally, we have identified a gap in the literature on the study of relevance, namely the issue of *input* relevance, related to situational, socio-cognitive and topical relevance; that is, to the actual use of information in proceeding information objects. In the past, relevance has been judged and discussed in terms of *access* (or retrieval) relevance. Relevance judgements regarding *inclusion, selection and representation* of information objects in information systems have not yet been explored profoundly. For instance, the acceptance or rejection of papers to conferences or journals, above seen as manifestations of socio-cognitive relevance, lead directly to the conception of *system-input relevance*. Issues of this type of relevance will be discussed in a future paper.

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