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Marek Nahotko

Instytut Informacji Naukowej i Bibliotekoznawstwa
Wydział Zarządzania i Komunikacji Społecznej
Uniwersytet Jagielloński

Where does new information come from?

Jak tworzona jest nowa informacja?

Keywords: ASK, information creation, transactional model
Słowa kluczowe: ASK, model transakcyjny, tworzenie informacji

Abstract

The article is an attempt to describe the conditions that lead to the creation of new information (which usually starts the process of publishing), as part of the process of scientific research. Models of information behaviour most frequently mentioned in the literature from sources like Wilson, Dervin, Godbold, Belkin et al. were taken under consideration. The author's own model is proposed, based on the assumptions of the Rosenblatt transactional theory and concepts of information load, which is a reference to the concepts of anomalous states of knowledge and information gap.

Abstrakt

Artykuł stanowi próbę opisu warunków prowadzących do tworzenia nowej informacji (co zwykle uruchamia proces publikowania), jako części procesu badań naukowych. Uwzględniono najczęściej wymieniane w literaturze modele zachowań informacyjnych Wilsona, Dervin, Godbold, Belkina i in. Zaproponowano własny model oparty na założeniach teorii transakcyjnej Rosenblatt oraz koncepcji przepełnienia informacyjnego, stanowiącego nawiązanie do koncepcji anomalnych stanów wiedzy i luki informacyjnej.

Introduction

In the paper, I engage in scientific information activities as a special case of overall, every day information activities, realised by people during all of their conscious and unconscious actions. Every human individual creates himself/herself in communication activities (Morner, von Krogh, 2009) and furthermore, the activities are necessary for the creation of the social community surrounding every individual and himself/herself as a part of it. Such a mode of existence looks to be an inherent part of human nature (Tomasello, 2015, p. 122). Every human being in contact with other people immediately starts interactive communication activities, leading to a change of everyone's minds and the surrounding objects. This is why knowledge, albeit individual, cannot exist without individuals being together in communication for purposes of information exchange. Individual knowledge is socially constructed (social constructivism).

The research process, regardless of the field of knowledge and research methods used, cannot be considered completed until the results are disseminated. Scientific communication, formal or informal, being an inherent part of every scientific activity, may be executed only through messages containing information. The information contained in the distributed message (the publication) is an effect of the realisation processes of organizing information, for which information organisation systems (IOS) are commonly used. Information organisation (IO) processes are used to facilitate the communication activities between the author (sender) and the reader (receiver).

In this paper, I will describe processes of information creation aimed at its dissemination as a part of scientific research. They are interactive processes where knowledge organisation (KO) and IO take place. The first means information internalisation aimed at a scientist's mental structures development and modification. The latter is knowledge externalisation and representation in the form of information, possible for dissemination and internalisation by others. Through these processes the knowledge structures of both the sender and receiver can be changed.

According to Anna Suorsa and Maija-Leena Huotari, by the end of the twentieth century the cognitive approach in LIS was dominant, which put an emphasis on the individual, internal information and knowledge processing. Then, interest slowly shifted

towards taking into account interaction between people, as well between the individual and the context. This change is also visible in research on information behaviour. It is noted that during the information behaviour, such as the search for information or information creation, people work together; this cooperation can take organised forms, for example, working in groups. On the other hand, the need to treat knowledge as part of the processes carried out individually is recognised (Suorsa, Huotari, 2014, p. 1042). The cited authors use hermeneutics to study the processes of knowledge creation, which is understood, according to the concept of Hans-Georg Gadamer, as not only the method of interpretation of the texts, but also a way of conceptualizing interpersonal interactions as open and dynamic processes of understanding, which takes place between the past (tradition) and the present (modern).

Based on previous studies, both cognitive and sociological, we can make some initial assumptions:

- Information creation is inherently social in nature, even if individuals create and receive information (write and read). These information transactions are not generally carried out in isolation, but rather in relation to the community of discourse, of which the individual is or wants to be a member;
- Information creation as a recursive social activity causes the development of structures of meaning: information content and form are tailored to specific purposes related to the recipient (genres);
- From the above, it thus follows that the creation of information and the meanings and values constructed by the individual depends on the purpose of information related to all spheres of his/her social activity; their diversity, and sometimes even the conflict between them, causes an obstruction in the process of information creation (Haneda, Wells, 2000, p. 342).

Interaction mentioned earlier, in opinion of some authors, is too weak a relation to describe interdependences existing in knowledge and information processes. According to Rosenblatt, some type of transaction takes place between a text and the author/reader (Rosenblatt, 1994, p. 1058). During the transaction, both the author and the reader are based on mental schemata created during experiences. Based on these the process of meaning creation is organised. Two persons who have achieved similar understanding of the information and/or data must have a common basic knowledge (cf. hermeneutic tradition), and thus a similarity in mental structures, although the similarity is never exact. Transaction is a much deeper process than interaction. It is used to designate a two-way relationship, in which one shapes and is shaped by the other (Rosenblatt, 1981, p. 180). Transaction is more organic and can be likened to a living organism. Knowing is a transactional relationship (Latham, 2014, p. 548). It is close to the phenomenological point of view, where an individual is understood in terms of his/her existence as a creator of the world while simultaneously being created by the world (Suorsa, Huotari, 2014, p. 1048).

Models of information creation

Information science specialists have explored problems of information behaviour, as well as information creation, for a long time and many models of the processes have been proposed. Particularly often the models of Tom Wilson (1997; 1999), Brenda Dervin (Naumer, Fisher, Dervin, 2008), Barbara Niedźwiedzka (2003) and Natalya Godbold (2006) are used and cited. The DIK cycle (Tian, Nakamori, Wierzbicki, 2009) also has some resemblance to the models mentioned. The older theory of anomalous states of knowledge (ASK) by Belkin (Belkin, Oddy, Brooks, 1982, p. 65) still plays an important role.

The ASK theory explains the formation of informational need. According to Belkin's theory, information retrieval occurs when the user finds the existence of a problem, identifying the inadequacy of his/her knowledge – anomalous state of knowledge. Belkin termed it anomalous, although from what was written earlier, it seems that such a state is a normal, everyday phenomenon. It is possible to explain the rise of a researcher's need for scientific information creation in a similar way. Some type of anomaly also characterises the state of knowledge of a scientist, who decides to become an author (i.e. for knowledge externalisation), but this anomaly has an opposite sign to anomaly described by Belkin. As far as a scientist-user is concerned, the anomaly has a negative sign (deficiency – a gap of knowledge), which the user is trying to compensate by seeking new information; the scientist-author's knowledge anomaly has a positive sign, because he/she has constructed the new knowledge and wants to externalise it.

In a typical situation, applied to solve both everyday problems as well as research problems, Bertram Brookes' equation is applicable:

$$K[S] + \Delta I = K[S + \Delta S]$$ (Brookes, 1980, p. 131).

This equation expresses the functioning of interactive process between individual, inaccessible thoughts and mental structures of a human and publicly available artefacts of information (Todd, 1999, p. 11). Peter Ingwersen, who adopted some additional assumptions, transformed Brookes' equation in an interesting way. Based on his assumptions Ingwersen transformed the equation as follows:

$$pI \rightarrow \Delta I + K[S] \rightarrow K[S + \Delta S] \rightarrow pI'.$$

It means that potential information pI is converted into information ΔI, which is mediated by the current state of knowledge K[S], transforming the knowledge state into a new state of K[S + ΔS] with effect (ΔS). A modified knowledge state can lead to the creation of information (pI'), potentially new for other users (Ingwersen, 1992, p. 31-32). In this way, the novelty of information is evaluated from subjective future users' point of view.

If an individual's state of knowledge is adequate to the problems solved by him or her, the need for information does not occur. The theory of determining the sense applies in everyday activities. The determination occurs in situation of absence of the ability to understand the occurred events due to the individual's knowledge structures inadequacy to the complexity of the situation. Determining such sense is an iterative process, aimed to match the cognitive models (schemas) to environmental changes (new information) (Jashapara, 2014, p. 151). People interpret new information in a way that allows for the creation of a new sense (meaning), which bridges the cognitive gap. The strategies adopted are the result of conceptualisation of both the gap and the bridge, as well as answers, ideas and resources acquired along the way. Part of that bridge, defined by Brenda Dervin as a sense made over a gap between two time-spatial moments and between the material and interpretative worlds (Dervin, 1999, p. 739), becomes information about the possibilities for the use of information and knowledge about the individual's situation, who is moving within the informational environment at that very moment (Spink, Cole, 2006, p. 27). Brenda Dervin also attributed great importance to emotions in the process of closing the gap, which can be just as strong a motivator, as the uncertainty of knowledge. Dervin's tendency has been to focus on individual sense-making. Alternative construction of sense-making was advocated by Reijo Savolainen in focusing on the social nature of sense-making (Savolainen, 1993).

Natalya Godbold, in her model, combined different approaches to information users and their needs (Godbold, 2006). The model describes human actions taken in the face of a problematic situation. It is a unique moment in which a person striving to realise the stated aim is experiencing the existence of information gap described by Dervin. The gap is an obstacle to the implementation of the plans; hence it is motivation to take action of any kind. It should be noted, however, that the gap is not objective; on the contrary, it does not exist if it is not perceived. From this, it follows that, as Godbold says, people behave differently in different situations – they often actively seek information, but it also happens that they acquire information passively or they are not involved in its collection at all. Intentional or unintentional access to information may result in further information behaviour. Among the set of possible actions, emerged based on selected information science concepts, the cited author distinguished the following:

- Building a bridge:
  - Subsequent information seeking, including information search.
  - Creation of new information.
- Close the gap:
  - Information spread, information dispute.
  - Information destroy.
- Not cross the gap, gap ignoring (change of behaviour):
  - Avoid information or disbelieve information.
  - Take mental note, often without concrete aim of use.

It can be considered that these behaviour types indicate the types of transactions with the source of information, which are chosen by the recipient and/or the sender of information. From our point of view, the most interesting behaviour is that leading to the creation of new information. Unfortunately, the model's author addresses the topic only briefly. She states that the gap causes information behaviours, but such behaviour, particularly information seeking, spreading and creation, could be also present without experiencing gaps, indicating some different kinds of stimulatory factors, such as experiencing the pleasure of discovering things, sharing it with others, etc. It seems, however, that these factors, although they play a role in the creation of new information, are not sufficient to explain and describe the process of creating new information in a science.

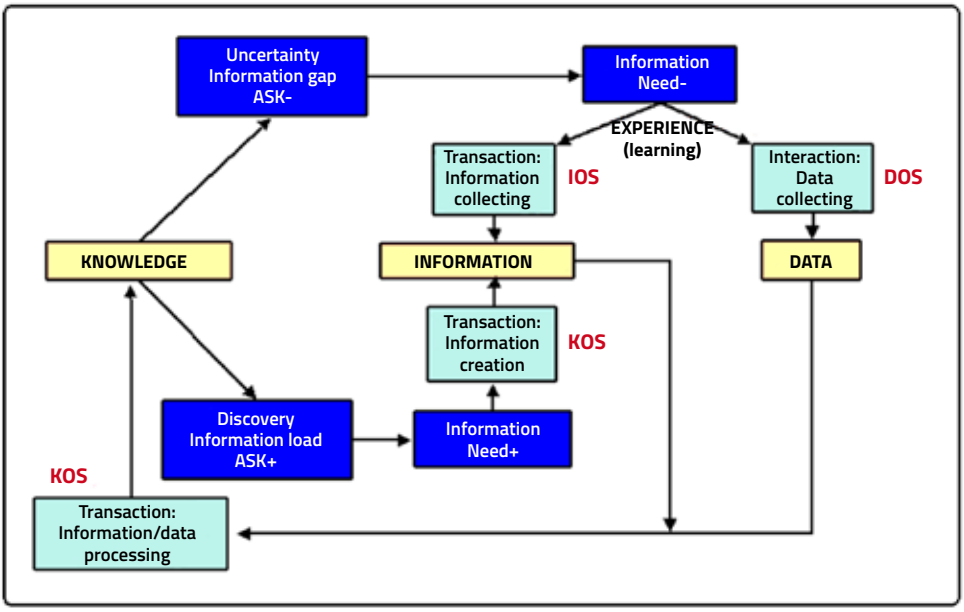
A new model of information creation

In the Godbold model the situation where an individual performs transactions, which are described as an attempt to building a bridge, namely seeking/searching for information or creating it is particularly interesting. The question is: what are the reasons for choosing one of these activities and not the other? In particular, when does an individual decides to execute a transaction of new information creation (writing), which, in science, is usually associated with its dissemination? It seems that the combined treatment of information seeking and new information creation in the Godbold model is too much of a simplification of facts, even for the needs of the model. These processes are closely related indeed, yet at the same time clearly separate.

A new model for information creation (IC) is needed. In this model, the IC is understood as a process of knowledge, in which new information is created in the transaction between individuals and information resources (e.g., the texts, including publications). Creation of scientific information occurs in the scientific community as a part of research work carried out in scientific institutions (Tian, Nakamori, Wierzbicki, 2009, p. 79). IC is the process of knowledge, because information without knowledge cannot arise, and knowledge without information does not exist.

According to the concept of Hans-Georg Gadamer, the co-founder of hermeneutics, new knowledge is created based on the knowledge possessed (tradition) on the basis of information that questions such previous knowledge. This process can be understood as an event that changes and grows the base of functioning with experience. In particular, the transactional event may be considered a reflexive action. Such actions in the hermeneutics tradition are associated with the idea of being aware of the situation (Suorsa, Huotari, 2014, p. 1052). Tradition and current experiences are the basis for the overall experience, understanding and learning in intentional transactions.

Figure 1. Transactional model of information behaviour



Source: The author's own work

Figure 1 represents the place of the IO and KO processes in a model of information behaviour, in that especially information creation. There are three stages featured: Knowledge → Information (Data) → Knowledge (new), which means there are existing feedback processes. Therefore, new knowledge is created based on possessed knowledge (tradition), formed on the basis of experiences (learning) up to now. These experiences arise in transactions with the information or interaction with the data coming from the environment and provide a foundation for creating something new. In this way, the factors belonging to the outside world, that shape knowledge, are divided into those that come from other people (communicated information) and come directly from the environment (experienced data). These transactions and interactions allow new connections and meanings to be seen, giving rise to new knowledge (Suorsa, 2015, p. 507). A scientist can be defined by the description of his/her experiences gained in transactions and ways of participation in these transactions. Scientists in transactions constitute information for the redefinition of problems and ways of solving them, and during these processes they re-create their research environment. The meaning of acquired information is always modified by the recipient, who makes interpretations based on his/her own experience and his/her own situation (context), on which the assessment of its relative novelty, inter alia, depends.

Figure 1 demonstrates three groups of elements: 1) abstract entities of knowledge, information and data, 2) subjective states of information gap and information load

indicating the existence of information need or ASK, and 3) transactions/interactions made between them. The subjective states of knowledge concerning the state of the individual mind are very difficult to research and describe. Instead, we can focus on the social activities of the individual, taken in relation to information needs. We can then deal with the transactions of the individual with the document, and more specifically with the information it contains. The idea of transaction/interaction becomes central to all human activities (Suorsa, Huotari, 2014, p. 1049). Therefore, those models that possibly accurately describe the transactions carried out, such as the models of Dervin and Godbold are of particular value. In this case, the IC should be associated with the idea of a human being constantly creating and being the object of creation in daily transactional activity. In this way, the model presented (Figure 1) can be based on the construction of the experience of the individual in the transaction, the structure of the transaction event and ways of a deeper participation in transactions.

Community members realising particular transactions are creators of commonly accepted (conventional) mental structures called document (text) genres. According to the definition presented by Misha Vaughan and Andrew Dillon (Vaughan, Dillon, 2006, p. 503), the genre is a class of communication events, which are characterised by having a common set of conventions and rules aimed at facilitating the interaction of communicating parties (users) by creating and handling (e.g., modification) expectations in the community of creators (authors) and receivers (readers). To the presented concept of a transaction as an experiential element of information and knowledge processes, the concept known as „format as a process" is related (Seeber, 2015, p. 23). According to the concept, differences between information genres do not depend on their external characteristics, such as medium (paper/digital), but on processes that allow one to create and use their text (information). What matters is thus a process of the transaction: the original author's idea and its execution (how, when and by whom), as well as the reader's need and possibilities of their satisfaction. Text creation processes are associated with different needs, motivations, values, conventions and practices. It is produced in a variety of formats, traditional or digital, but the essential issues related to the value of information and its potential use are more important than the physical package of the source of information (ACRL, 2014, p. 15). This means that the correct distribution of genres should be done based on differences in the management of information (e.g., text) – both by the author and the reader, as well as various types of intermediaries. This causes the transition of attention from the final product and its classification toward taking into account the pattern of transactions that define the document text.

The top portion of Figure 1 refers to a situation of uncertainty, indicating the information gap of the individual facing the problem that needs to be solved. An information gap is a subjective state of mind. According to the Godbold model an individual may use different information strategies, depending on the situation. From the point of view of the model presented in Figure 1, the most interesting is seeking information (destruction or omissions of information can be treated as auxiliary in the process of

research). Its result is a collection of information (studying of sources, documental or personal) or data (results of experimental studies). Both of these processes, because of information/data is processed during internalisation, affect the state of knowledge of individuals who have access to information/data; in an ideal situation it would lead to the knowledge increase.

Also, the information load[5] is a subjective mental state, which, in science, requires verification. It is realised by using various procedures, such as reviewing. The verification causes that knowledge is treated as correct belief (mental structure), motivated or confirmed by commonly accepted criteria in the knowledge community. These criteria determine what sources or methods of acquiring belief are considered to be reliable enough to provide treatment of beliefs as knowledge within the community of knowledge (Dijk, 2014, p. 43). It follows that socially constructed evaluation criteria are used for respective beliefs, by which information, as well as its mediation knowledge, are negotiated by participants of the knowledge transaction. In this way, discourse, understood as a form of transaction with information in the community, should be considered as the main source of knowledge. Another source of knowledge is interaction with data collected in the non-social environment, providing beliefs about the environment.

In the model, it was accepted that the information is created only in the process of externalisation of knowledge, being a subject of interpersonal communication. These processes have transactional characteristics. On the contrary, the data is produced during the direct examination of objects of non-social environment, for example in laboratory studies, without communication, with use of data organisation systems (DOS). These processes have interaction characteristics. Data can be distributed in unprocessed form or can be processed directly into knowledge that can be further externalised in the form of information. During information creation, knowledge organisation systems (KOS) are used for the transformation of knowledge into information of specific genre. These KOS includes a special kind of knowledge called genre knowledge.

At the bottom of Figure 1, processes of creating new information in an information load situation are presented. It is expected that the scientist becomes an author if his/her knowledge level reaches the creative level, which provides the information given in the text of the peculiarity of a novelty (Bawden, 2011, p. 106). The author cited distinguished three categories of changes in mental structures that can occur as a result of obtaining information: a) confidence change, information can increase or decrease the strength of components of knowledge structures; b) expansion change, growth of knowledge structures, information results in new concepts or relations; c) disruptive change, causing qualitative changes in the structures of knowledge. Certainly, the third kind of change can be seen as a reason to create new information.

[5] The mental state of information load, needed to create new information, must be distinguished from the injurious state of information overload, impeding the creation of information by blocking the mental processes.

Brookes and Ingwersen's equations, mentioned above, relate to knowledge structures and the possibility of internalisation of information by individuals. In science, however, it is necessary to see these processes in the context of the social environment, where new information is created only if it has a novelty value, not only from the point of view of the increase of knowledge of the individual, but also of some maximum state of knowledge in the area of knowledge (over "calculated" common ground). In the process of research, data and information internalisation is performed until the increase of knowledge of the researcher is large enough that it exceeds the level of knowledge (usually in some extent) of other people involved in the same research, which I have marked as K_{max}. The shared level of knowledge (common ground) is defined for a specific communicative situation, like presupposed shared knowledge of authors and readers of scientific papers. There is thus some critical knowledge level Kmax, beyond which the researcher decides to complete the process of internalisation of information (ASK-) and starts creating new information (ASK+). Here, interactions with data gathered in the research process are crucial, as it is the value-added (new knowledge), because information transactions allow to specify only until-critical (current) state of knowledge. We can record the relationship as follows:

$K_{max}[S] + \Delta I + \Delta D \rightarrow K[S + \Delta S] \rightarrow \Delta I'$ (Nahotko, 2014, p. 458).

This means that if the $\Delta K > K_{max}$ then I' appears (new information is created). In other words, when the author feels subjective, but based on communication transactions and interactions executed, an increase of his/her knowledge over the level of knowledge of other people involved in the same research area (common ground), the creation of new information takes place. This level of knowledge, understood as all the knowledge available in the community, by hermeneutical theories is called tradition (Morner, van Krogh, 2009, p. 432). An increase in this knowledge can be achieved in different ways; many theories of creative activity stress the role of unconsciousness in the process. There are many indications that the role of a complicated system of communicative transactions, made constantly by scientists, is ultimately creation of sensations like ‚Eureka!', when scientist who is busy with everyday activities or who is waking from sleep suddenly realises that he/she knows the solution to the problem with which he/she has struggled for a long time. Based on a similar scientist's reports, the psychological theory of scientific discoveries was developed by Arthur Koestler (1981). In his opinion, scientific discovery lies in the combination of two ideas, facts or theories, none of which previously were connected with each other. Associations shall take place largely on a subconscious level, because awareness is much too reasonable. Of course, the subconscious must receive an adequate basis (communicative transactions) from the conscious for subconscious associations to be made. Just the product of these associations is made available to the conscious. A similar combination of rationality and accidental events can be seen in terms of information-seeking strategies, where, in addition to regularly viewing of

selected journals, there is also a place for much less planned and rational techniques like berrypicking (Bates, 1989).

As we can see, both states of knowledge (the state of the information gap and the state of information load) can be considered anomalous, because they require transactions directed at information. Depending on the relative level of individual knowledge, the person decides to search for information or to create it. The new, communicated information increases the K_{max} of not only the creator of the information, but also all participants in the transaction of scientific communication who are capable and have the need to internalise this information.

Note that in the creation of new information, a variety of knowledge structures are used, including those that result from recurrent transactions with information. With this repetition of transactions, a typification of the action of information creation, or genre conventionalization, occurs. As was mentioned, these conventions function as KOS. The formation of genre knowledge accompanies the emergence of other structures of knowledge about that part of reality where transactions with the information occur, i.e. all social activities. This understanding of the genres means information creation cannot be treated as a single process. Various genres of documents containing the information, necessary for various socio-rhetorical purposes, require different strategies to achieve those purposes. According to Scardamalia and Bereiter (1987, p. 177), during the transformation of knowledge into information, this process is mediated by active troubleshooting, or reflection. To do this, a transaction using the genre is required, defining the form, content and socially agreed communication objectives of the text. Consequently, information creation is not only used to reproduce pre-existing mental structures (memory), but is also to create new content, if the existing content is not suitable for the aims pursued. This process, in turn, can lead to a modification of knowledge structures.

Conclusions

This article presents a model of individual knowledge creation based on internalised information and data, and information creation (IC) in the social process of the externalisation of knowledge. In both of these processes, information transactions play a key role. Putting all transactions relating to the creation of data, information and scientific knowledge into a single model allows us to identify the various stages of these processes and assign places of elements taking part in them. The proposed model allows for a strict distinction of knowledge as individually (although in social context) constructed mental structures and information, which is the subject of the interpersonal communication processes in which these structures are represented.

According to the prior models of Dervin and Godbold, the transaction of information creation was considered as a type of information behaviour, but differed, however, from other information behaviour in that it occurs during the subjective perception

of information load (ASK+), and no information gap (ASK-), although both of these states are linked by feedback. The transaction of information creation takes place when the author feels an increase of knowledge (subjective, but based on communication transactions executed) over the level of knowledge of other people involved in the same research area (common ground). The subjectivity of the information load state causes the need for standard novelty verification made by the community members, in the community in which scientific communication is taking place.

The repeatability of these transactions allows their typification, which affects the formation of common document/text genre conventions of a given communication community. On the one hand, they facilitate the implementation of the basic transactions mentioned, and particularly information internalisation and knowledge externalisation; on the other hand, they also support other transactions associated with these, like the quality assessment mentioned. They allow for an easy transition from the individual dimension to the social dimension of knowledge transactions.

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