Chapter 4

SCRIPTING IN NET-BASED MEDICAL CONSULTATION: THE IMPACT OF EXTERNAL REPRESENTATIONS ON GIVING ADVICE AND EXPLANATIONS

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Abstract: In this chapter, a distinction is made between three concepts of scripting communication: 1) social roles as a non-deliberative, non-instructional form of scripting, 2) explicit and 3) implicit scripting. Both of the latter are forms used in instructional collaborative settings to influence and change behavior. As we established in a previous study, external representations both structure and constrain asynchronous expert-layperson communication (Bromme, Jucks, & Runde, 2005). According to Suthers (e.g., Suthers & Hundhausen, 2003), external representations guide discourses. Because shared external representations have the potential to influence learning and collaboration processes in a non-directive manner, we define the concept of *representational guidance* as implicit scripting. In the present study, we focused on the potential to support shared decision making when patients seek advice from medical doctors through the Internet. When communicating via computers, it is easy to make external representations available to both communication partners. Therefore, whether or not shared graphic representations function as an implicit script and have an impact on the communication content was tested empirically. Our main hypothesis is as follows: with a shared external representation in the background more specialist arguments are brought forward than without such a representation. In accordance with this hypothesis, we found that the external representation had a considerable influence on content selection during the discourse.

1. BACKGROUND

More and more people with varied degrees of expertise turn to the Internet as a source of medical information. Many web sites offer medical advice. In addition there are a number of other options available for using the Inter-

net in the context of health communication, such as mailing lists, communities, newsgroups, chats or conventional email. It is possible to differentiate still further: who provides information and who communicates with whom? Some self-help groups, for example, use the Internet. Although most of these people have no medical training, they usually have some expertise about a particular disease. Additionally, there is the option of communicating via the Internet with professional people who *have* had medical training. Net-based communication scenarios between medical experts and laypersons have begun to complement traditional doctor-patient communication to a significant degree. Uncertainty is the most common reason for visiting a website to obtain health information (Pezza, 1990). The Internet is used to obtain a second opinion, complementing what has already been learned face-to-face (Koc, 2002) as well as a first opinion in order to decide wether a consultation is necessary or not. After a television program on health matters, people frequently take up the offer of communicating in a chat room with a medical expert from the program. Health Internet portals, such as health.yahoo.com, not only provide up-to-date information on many diseases or access to encyclopedias with information on topics such as laboratory results, medication and symptoms, but also allow the user to consult an expert via e-mail or chat on a particular health topic (sometimes on payment of a fee).

An extensive use of the Internet is concomitant with a changed role for the patient in the doctor-patient relationship. Patients might have gathered relevant information themselves and this might lead to a more symmetric doctor-patient-relationship. Traditionally, the doctor-patient-relationship has been perceived in a paternalistic manner. Accordingly, the patient was totally dependent on the doctor, who assumed the dominant role and decided on the course of action with respect to the disease. The patient was then expected to follow the doctor's advice. In this scenario, the personal opinions and values of the patient played only a minor role in decision-making processes. Over the last few years, an alternative understanding of the relationship between doctor and patient has become accepted, in which the patient is "allowed" to assume a more active role. As proposed in the shared-decision-making model and as the name implies, decision-making is shared by doctor and patient, both during the consultation process and throughout the treatment. In 2001, the German Federal Ministry of Health and Social Security launched shared decision-making as its main research topic (http://www.patient-als-partner.de [patient as a partner]). The shared-decision-making model has various different facets and conditions that must be met for it to succeed. One of these is integrating the patient's preferences into the decision-making process with respect to treatment or prevention, together with providing medical or scientific knowledge from the doctor. Moreover, if the model is to succeed, a mutual exchange of information and

sufficient relevant expert advice to patients is a sine qua non. Only then can the patient be considered 'medically mature' and able to take an active role in decision making. Ideally, the advice should comprise a detailed explanation of the disease (risks, potential complications, other related diseases, etc.) and possible treatments (What therapies are there and what are the various advantages and disadvantages, etc.?).

The shared-decision-making approach seems essential for ensuring patient compliance and for improving other relevant patient-related variables such as satisfaction (e.g., Dowell & Hudson, 1997). However, the practical application of the approach appears problematic. Several empirical studies demonstrate that conveying expert information often plays an insignificant role in doctor-patient communication, even in dedicated counseling settings. Such counseling is frequently conducted on a superficial level as far as expert knowledge is concerned, the advice given being restricted to behavioral instructions (Tulsky, Chesney, & Lo, 1995). Many patients report dissatisfaction with their communication with physicians. They complain, for example, of a lack of information about possible alternative treatments. There are undoubtedly a number of situations where it might be more effective not to indulge in long and informative dialogues. Conversely, it is possible for patients to end up with unsuitable treatment if they, along with their opinions and preferences, are not included in the decision-making process (Coulter, Entwistle, & Gilbert, 1999).

Consequently, deploying the shared-decision-making model successfully requires a change of behavior on the part of both communication partners. If doctors wish to help patients make an informed decision and share the decision-making with them, it is imperative that they not only give behavioral advice, but also supply expert content and related background information. An informed decision is defined as the reasoned choice by a 'reasonable' individual on the basis of relevant information about the advantages and disadvantages of all possible courses of action and in conformity with individual attitudes (Bekker et al., 1999). To sum up, there are conflicting and diverging goals and processes in doctor-patient communication. On the one hand – and in the sense of the shared-decision-making model – it is necessary to communicate relevant medical information and to improve patient involvement. On the other hand, traditional social roles create communication patterns which prevent patients from assuming more responsibility.

How then should the behavior necessary for shared decision-making be fostered?

There are different approaches to fostering patient involvement in the communication process with physicians. Such processes usually consist of training one or other of the communication partners (the patient or the doctor). Various empirical studies provide evidence that it is worth attempting to

integrate new thinking about the role of the patient into these schemes. After training patients, Kaplan, Greenfield, and Ware (1989) found indications that there was more patient involvement during interaction with the doctor and better health outcomes when patients had been taught to ask more appropriate questions during consultation, and had been given more specific information about treatment options than patients in a control group who had received only general information. As a result, diabetes patients who had received training and became more involved, achieved better control over their blood sugar levels.

Training schemes generally focus on improving the quality of advice doctors give to patients and on increasing patient knowledge by furnishing them with more material about the relevant health topic. However, most training is cost-intensive and not easily adapted to specific patients. It is neither possible to train all potential patients to ask appropriate questions, nor does the provision of expert information such as brochures on display in the waiting room guarantee that they will be read, let alone understood. Training doctors has also proven difficult, primarily because they have such tight schedules. Adapting training courses for doctors along these lines and educating patients in areas relevant to their complaints through training schemes certainly makes sense, but needs to be supplemented by further measures, starting with general communication skills and an appropriate structuring of the communication situation itself.

In this connection, Internet-based communication between doctor and patient is a good starting point, given that, as mentioned earlier, it enables patients to seek information, and because the technical environment makes it possible to offer direct support.

In the following section, we present a method which uses external representations (graphics) in Internet-based communication settings. We refer to this method as an *implicit script*. In order to clarify this approach, it is necessary to explain the concept of implicit scripts in more detail (for a general introduction to the concept scripts see Fischer, Kollar, Haake, & Mandl, this volume, and King, this volume). Therefore, we describe three concepts of scripting – social roles, explicit and implicit scripts – and differentiate the first two clearly from the concept of implicit scripting.

2. THREE CONCEPTS OF SCRIPTING: SOCIAL ROLES, EXPLICIT SCRIPTS, AND IMPLICIT SCRIPTS

2.1 Social roles as determinants of the structure of interaction

Social roles are prototypical scripting concepts, first introduced to psychology (by Schank & Abelson, 1977). In this "original" sense, the behavior of physician and patient follows a well-established structure of which both parties are aware. Scripting through social roles determines their behavior inherently, whereas instructional concepts of scripting refer to a planned impact on specific behavior, guided by instructional objectives. The chapters of this book are mostly based on this instructional understanding of *scripting*. In contrast to the concept of scripts in instructional settings, social roles lead to a pre-structuring of communication situations without being *deliberately influenced* by someone else (except for the process of learning to act according a social role, for example, during an apprenticeship). As the very familiar example of the restaurant script illustrates (Schank & Abelson, 1977, see King, this volume), agents follow a script and in so doing, enact their social roles. The roles of doctor and patient are scripts in that traditional sense (Schank & Abelson, 1977). They are relatively fixed roles which do not have to be negotiated afresh at the start of every new interaction. There is little scope for individual structuring, which derives mainly from the typical dependency relationship between the two speech partners. Roles of this kind reduce the complexity of interactional possibilities (Luhmann, 1999), which implies that roles do help facilitate and simplify interaction processes. They pre-structure them and provide patterns of behavior. In this manner, the social roles of communication partners function as scripts.

The substantial difference in knowledge between the two sides is largely responsible for these behavior patterns. The expert is the adviser, explainer, and helper. Laypersons find themselves in a position where they are dependent on the expert. They have a problem with respect to which they turn to a communication partner. They ask questions, hoping for advice and help. The clear allocation of roles determines the selection of communication content, which in turn structures the communication. In addition to the cognitive processes involved in communicating information, expert-layperson communication is characterized by a number of typical social processes and features. Wintermantel (1991) stresses the asymmetry of this communication situation (compare Watzlawick, Beavin, & Jackson, 2000), also describing it as an instructional dialogue. On the basis of the unequal distribution of knowledge between the two communication partners, the expert dominates

the discourse. "This particular dominance relation, due to knowledge superiority, provides a regularity which is accepted by both participants at the outset. For the one delivering the instruction, it should be clear that s/he is ready to transfer her/his knowledge. For the one who wants to learn in the course of the dialogue it implies acceptance of the dominance of the expert" (Wintermantel, 1991). An awareness of this asymmetry and its implications can be regarded as common ground between the communication partners (Stalnaker, 1978). As a further characteristic feature, Wintermantel (1991) describes the goal orientation of communication: "... the explicit intention of the two participants to contribute to a common goal, namely that of equalizing the initial unequal knowledge distribution". However, these characteristics are understood as inevitable in such a situation. Apart from the fact that some communication tasks and situations where the layperson assumes the more dominant role are conceivable (e.g., during the course of an anamnesis in the doctor-patient communication), it is questionable whether mutual goal orientation can always be assumed, in particular a mutual goal orientation where both partners are interested in equalizing the differing knowledge levels. A number of conflicting goals are conceivable which may not always lead to the expert giving comprehensive expert information.

As with other roles (e.g., gender roles), notions of the ideal roles of doctor and patient have changed over time (Coulter, 1997). Presently, the generally prevailing view is that patients should be (put) in a position where they are able to make decisions regarding their health in cooperation with the doctor. However, so far, there is little evidence of this happening in practice – needs and reality are still poles apart. The traditional roles still seem to apply, dominating communication structures. As already mentioned, the long-established roles and their accompanying scripting can prevent communication from being as effective as it should be. Therefore, it is necessary to implement alternative scripts which influence the behavior in the appropriate manner.

2.2 Cooperation scripts as explicit instructions

In contrast to the inherent structuring of communication through social roles, instructional principles are implemented when designing goal-oriented communication (cooperation scripts are a good example). Instructional designs use these scripts primarily to support participants in collaborative learning situations so as to encourage the selection of appropriate learning and communication strategies.

Cooperation scripts regulate the sequence and timing of learning and interaction activities. "The roles and the nature and timing of the activities of the participants are specified." (O'Donnell & Dansereau, 1992, p.122). For

instance, they prescribe when and how one learner should give feedback to another learner, and how the latter in turn should react. It is possible to differentiate between cooperation scripts which focus more on interaction and those which focus more on communication content. Ertl, Fischer, and Mandl (in press) also differentiate between support for collaborative learning on a conceptual level, comparable to the focus on content, as opposed to a socio-cognitive level, which is comparable to the interaction focus. Interactional scripts, which foster appropriate cooperation patterns, are concerned mainly with the construction of knowledge. Content-based scripts focus on supporting the processing of the task content, by, for example, repeatedly asking learners to make certain inferences about the text they have studied.

Hence, cooperation scripts can be characterized as follows: a) they are deployed deliberately and b) they contain specific instructions. We therefore define this type of scripting as *explicit* scripting, which directly regulates the communication process and the structuring principles of which the communication partners have conscious knowledge.

Recently, studies have confirmed the effectiveness of various cooperation scripts in computer-mediated environments (e.g., the contributions in this volume; Dillenbourg, 2005; Rummel & Spada, 2005; Weinberger, Reiserer, Ertl, Fischer, & Mandl, 2005). Hence, it can be argued that this form of scripting communication situations has proven valid. Due to their explicit character, these scripts always create a specific instruction setting which in turn demands the communication partners' full attention and a high level of motivation. Intervening in a "natural" communication process and structuring the process by coercion can, of course, also have negative consequences, too. Moreover, Weinberger, et al. (2005) discuss "overscripting effects" (compare Dillenbourg & Jermann, this volume) which "may ease the learning task in an exaggerated manner, reducing the complexity of learning tasks, and hampering productive discourse of learners" (p.35). Particularly in real-life situations, there is a danger that explicit scripts, like cooperation scripts, could have these disadvantages (Baker & Lund, 1997).

2.3 External representations as implicit scripts

Apart from using explicit scripts for structuring the communication process, there is also the option of *implicit* scripting. By means of shared external representations (available to both communication partners), it is possible to facilitate an implicit structuring of the content of a communication process.

We believe that the concept of representational guidance suggested by Suthers et al. (e.g., Suthers, 2005; Suthers & Hundhausen, 2003) describes this script effect, which will be explained in more detail below. In fact, Suthers introduced the concept in another context and from another perspec-

tive, but embedded in the theoretical debate about scripting, representational guidance clearly works as implicit scripting. Suthers (2005) uses the concept of representational guidance (or affordances) to explain collaborative learning processes in computer-mediated communication. He emphasizes that external representations on the one hand constrain the communication processes (in the past, he labeled this effect as *representational biases*), but on the other hand, this restriction may lead to a task relevant focus. For this reason, we describe this effect as scripting. Depending on the specific content and character of a shared external representation in a collaborative setting, the structure and content of the interaction will be *guided.*

Suthers and Hundhausen (2003) examine the impact of external representations on collaborative learning processes. They claim that different representation formats each have their special characteristics which influence the cognitive processes of "readers". Accordingly, the attention necessary to acquire information is guided along different paths, depending on the representation format. In addition to the effects of external representation on individual learning and problem-solving, the authors assume that external representations provide special supportive effects in connection with collaborative learning scenarios: they (a) stimulate negotiating of meaning (b) provide points of reference for abstract concepts and (c) play a role in the implicit assessment of common ground.

Collaborative learning processes and their results depend on the specific manner in which external representations have been presented. Depending on the format chosen, different types of information are emphasized. Suthers and Hundhausen (2003), for example, investigated the influence of three different representation formats (graphics, table, text) on collaborative discourse and learning outcome. Learners were asked to summarize information about public health issues, formulate hypotheses and identify relationships, with the aim of finding a solution to a particular problem. They were required to perform the task in one of the three representation formats. The representation format did, indeed, influence the focus of the discourse. If, for example, the information was presented to learners in tabular form, they gave valid relationships far more frequently than learners in dyads where graphics and texts were used. Furthermore, the representation format influenced overall learning success. The influence was strongest for those learners who had worked on the graphic format. The authors argue that not every format is equally well suited to a particular task. It could, for example, be observed that learners working with the graphic format exchanged many irrelevant kinds of information as well.

However representations already containing expert information can also influence communication processes. In one of our own studies, we examined the impact of external representations on the recipient-orientation of experts

in an asynchronous email study (Jucks, Bromme, & Runde, 2003, 2006). The investigation entailed medical experts receiving an email inquiry from a (fictitious) patient. They had an external representation on hand in the form of an illustration containing the expert information necessary for their answer. In one condition, they were informed that the same information was also available to the patient. In another condition, participants were told that the patient did not have the same information. Informing participants of the shared availability of the illustration had a significant effect on the choice of content used in the explanations: medical experts with a *shared* illustration on hand gave a more detailed answer. They used more technical terms and explained more of the specialized interrelationships depicted in the illustration. These results can be interpreted as representational guidance effects. If shared, the external representation determines the choice of communication content and consequently functions as an implicit content script. Whereas Suthers and Hundhausen (2003) pointed out that different representation formats lead to different main focuses, Bromme et al. (2005) stressed the importance of *sharing* a representation in a communication scenario.

As well as establishing a mutual cognitive framework, it can be assumed that this implicit form of intervention does not have disadvantages as demotivating or distraction which sometimes come along with explicit forms of cooperation scripts. It does not intervene directly in the "natural" communication process. On the one hand, the implicit script of a shared external representation does not have the negative effects of "classic" scripting in the form of explicit cooperation scripts, but on the other hand, it is doubtful whether implicit scripting has any effect at all on communication, because it is non directive.

To sum up, we described three kinds of scripting communication. The non-deliberative, non-instructional form of scripting through social roles is a culturally-formed anticipation of behavioral patterns. It cannot be regarded as an instructional intervention and is not limited to a specific communication scenario, unlike deliberative, instructional scripting. This kind of scripting is generally introduced by a third party within a collaborative learning scenario. We differentiated between two kinds of deliberative scripts in instructional settings: explicit and implicit. Explicit scripting through cooperation scripts intervene directly in the communication process and this may be noticed by the participants. Implicit scripting represents a communication structure which is optional and introduced indirectly.

3. RESEARCH QUESTIONS

The results of the abovementioned studies of Suthers and Hundhausen (2003) as well as of Bromme, et al. (2005) provide evidence of the impact of shared external representation in the form of implicit scripts. In the study described below, this impact was tested in a synchronous expert-layperson scenario.

In the above section, an issue in doctor-patient communication was described and discussed: how can traditionally structured doctor-patient communication be shaped toward a more balanced and shared decision-making?

The question arises as to whether there are economical efficient ways and means of making the communication between doctor and patient more effective by stressing the relevance of content. For this purpose, we draw on the concept of representational guidance. If, in doctor-patient communication, a graphic illustration with relevant content is available, are the communication partners more likely to use the information given in this form during the discourse? As discussed above, this kind of intervention can be seen as an implicit content script. Illustrating the content imposes a certain *content* structure, which leads, in turn, to a formal *discourse* structure. It functions, in effect, as a third "speech partner" which can focus attention on the matter at issue again and again, thus helping to create both external and cognitive frameworks.

The representation of relevant content by means of logically-structured diagrams seems to be a particularly meaningful form of intervention in the context of instructional content scripts. For a communication situation between two speech-partners with different knowledge backgrounds, content representation by means of a logical diagram, such as a concept map, for example, can create an external cognitive framework.

We build on the results of Suthers et al. (e.g., Suthers & Hundhausen, 2003) and other researchers (e.g., van Boxtel, van der Linden, Roelofs, & Erkens, 2002) and our own email study (Bromme et al. 2005). These studies demonstrated the effect of shared external representations or the mutual externalization of expert content on the discourses structuring in collaborative learning settings. This resulted in higher task orientation and suggested the following assumption. If an illustration is provided to both speech partners in Internet-based doctor-patient communication, it encourages participants to use more specialist information during the interaction. In this manner, the shared illustration contributes to the success of shared decision-making and reduces the conflict arising from traditional social roles. Therefore, the key question is as follows: does a shared illustration function as an implicit con-

tent script and thus support shared decision-making? And how extensive is its impact?

In our study referred to above, we found evidence that shared external representations influence the content of asynchronous, Internet-based communication settings. We examined the influence of external representations in a synchronous communication setting (see also Runde, 2004).

4. MAIN FINDINGS

For this purpose, we asked a medical doctor to advise a medical layperson in a chatroom. In one condition, both doctor and layperson had a concept map at their disposal (experimental condition). In a second condition, only the doctor had this concept map (control condition). The concept map contained various relevant expert concepts and associations (see Figure 4-1). We used the CoolModes software (by Hoppe & collaborators, University of Duisburg; see Pinkwart, Hoppe, Bollen, & Fuhlrott, 2002) for the environmental design. The communication partners in the experimental condition were able to make written annotations on the concept map which were also visible on the other person's monitor.

Prior to the communication with the doctor, the medical laypersons were instructed to think of themselves as patients who had to make a decision on the choice of medication for hypercholesterolemia. They were also told that it would be possible for them to consult a medical doctor in the chatroom and that after the consultation, they would have to make a decision for or against a particular cholesterol-reducing medication. After the chatroom consultation, the subjects were asked a few questions and then asked to make their decision. We expected the availability of a shared concept map to influence the communication content.

In all, 36 dyads were examined. Half had a shared concept map on the monitor at their disposal (see Figure 4-1). Each dyad consisted of an advanced medical student and a medical layperson, that is, a student studying some other non-medical subject. The focus of the assessment was on the analysis of formal and, in particular, content-related aspects of the discourses. In the experimental condition with the shared concept map, discourses were more detailed in terms of the number of words used. Subjects also employed more specialist terms in this condition. These results can be attributed mainly to the fact that communication partners made more use of the specialist terms which were also contained in the map. A similar result can be found in the analysis of the specialist arguments. In the experimental condition, the medical experts used more specialist arguments and, above all, arguments which were also contained in the external representation. How-

ever, not only the experts were influenced by the shared concept map, but also the laypersons. They asked more medical questions about the content of the concept map. By contrast, there were no differences between the two conditions with regard to personal data given by laypersons and the behavioral instructions given by medical experts.

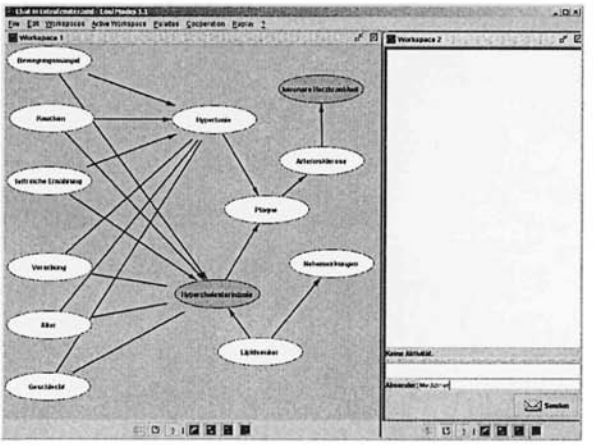

Figure 4-1. Environment of the experimental condition

The results confirm the hypothesis. The shared external representation, here in the form of a concept map, exerted a considerable influence on content selection in the discourse. The communication partners were guided towards the information depicted in the concept map, making it the content of their communication. Additionally and independently of sharing the concept map, there seems to be a basic "stock of information" that was conveyed in the communication, e.g., the anamnesis information and behavioral tips, and a selection of relevant specialist information. However, more extensive expert information was given more often in the experimental condition.

However, the influence of the shared external representation does not extend beyond the immediate subject matter. It could be assumed that the increased use of specialist arguments leads to a specialist focus in general like a priming effect. However, we are dealing with a very specific effect. We did not find a transfer effect. The content of the dyad discourses with the shared concept map did not generally include any more expert information. It seems, therefore, that the communication process is guided in a specific direction. Because of the selection of a control group in which the medical experts also had the specialist illustration, we can exclude any notion that the experts merely ticked off the information it gave them as a checklist for for-

mulating their replies. If that had been the case, there would not have been any differences between the conditions.

All in all, the results reveal an implicit script effect analogous to the representational guidance concept of Suthers and Hundhausen (2003). The communication was influenced in the intended manner by sharing the structure and content of the external representation. The communication partners used more of the specialist information depicted in the external representation. The constrained effects on the content of the shared external representation also replicate the results from our previous email study (Bromme et al. 2005). Our earlier study demonstrated an increasing use of the illustrated information in an asynchronous communication setting when the external representation was shared with the communication partner.

5. CONCLUSIONS

The results of our study mentioned above, show that external representations guide discourse and, above all, the content of the medical advice in a certain direction and influence the selection of information. The representations influenced the communication between doctor and patient. In this connection, the content and the manner in which they were represented play an important role in the level and nature of the discourse (compare Jucks, Bromme, & Becker, 2006 for the impact of word use in graphic representations on experts' communication). Restrictively, it must be point out that we did not analyse real doctor-patient-communication. It is assumed that in such communication settings many other factors affect communication such as the strong dependence on the doctor, time and institutional limitation, anxiety and other emotions on part of the patients etc. From this it follows that we can not translate our findings directly into the 'real world' doctor-patient-communication. Nevertheless we can conclude that comparable effects occur different communication scenarios with great knowledge differences between the communication partners.

Although, apart from one compulsory topic, the tasks were open-ended and the intervention was not very directive, the external representation contributed towards guiding discourse content in the assumed direction. That is, it increased the amount of relevant expert knowledge content in the contributions. This is even more remarkable when we consider that no explicit request was made to use the representation. In this sense, the external representation functioned as an implicit content script which determined the issues discussed. The results of both the study using asynchronous communication scenarios, and the email study reported elsewhere (Jucks et al., 2006) point to this direction.

Despite the differences between our study design and that of Suthers and Hundhausen (2003), the reported results are quite comparable. Hence, the concept of representational guidance can be extended to expert-layperson communication scenarios and communicating with already-existing external representations.

The implicit form of scripting tested in this study has the advantage of influencing the communication process in a very unobtrusive manner without interrupting it, as is the case with such alternative forms of scripting as cooperation scripts. The specialized information is available to participants via the shared external representation throughout the communication. Although the shared illustration constantly reminds the speech partners of the meaning of certain specialized terms during the course of their communication, it does not interrupt them. The illustration becomes part of the "natural" communication process.

The question arises as whether the concentration on the specialized content can be fostered if the communication is scripted explicitly or at least partly explicitly. For example, the communication partners might be briefed to take the concept map into account during discourse or, as in Suthers' learning settings, asked to adapt the relevant content so as to produce a concept map themselves. This might probably have been at the expense of other, equally relevant discourse content, such as the exchange of anamnesis information and behavioral tips. Therefore, further research is necessary to investigate and differentiate between the conditions of those communication settings in which external representations are useful and those in which they can do more harm than good.

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