Understanding and Supporting Intersubjective Meaning Making in Socio-Technical Systems: A Cognitive Psychology Perspective

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Abstract. This dissertation will elaborate on the understanding of intersubjective meaning making by analyzing the traces of collaborative knowledge construction users leave behind in socio-technical systems. Therefore, it will draw upon more theoretical and more formal models of cognitive psychology to describe and explain the underlying process in detail. This is done with the goal to support intersubjective meaning making and thus elevate informal collaborative knowledge construction in nowadays affordances of social media.

Keywords: Intersubjective Meaning Making, Co-evolution Model, Distributed Cognition, Artifact-Actor Networks, Social Semantic Server

1 Introduction

The planned dissertation will consider collaborative knowledge construction in socio-technical systems from a cognitive psychology perspective to shed more light on the process of intersubjective meaning making (IMM) and provide it with adequate support. As essence of collaboration [10], IMM appears in the interactions of persons with or within all kinds of artifacts (e.g., documents, pictures & chats): i.e., it "takes place when multiple participants contribute to a composition of inter-related interpretations" [12]. Such situations are in particular present in so-called *Artifact-Actor Networks* (AAN), which are an approach to combine networks of artifacts (e.g., Wikipedia[1]) and social networks of actors (e.g., Facebook[2]). An example for such a network can be found in the *Social Semantic Server* (SSS), which is intended for providing the fundamental basis for the European large scale integrated project *Learning Layers* (LL) in the area of informal, mobile and collaborative learning at the workplace.

To be able to assist self-directed learners in these informal socio-technical learning environments with meaningful help and to support them in collaborative

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[1] http://de.wikipedia.org/
[2] http://www.facebook.com/

situations, it is necessary to understand IMM in detail: i.e., to understand the more technically influenced term with respect to the underlying process from the viewpoint of socio-cognitive theories, such as Distributed Cognition [5] and the co-evolution model [2]. Therefore, this dissertation will develop an integrated model, which is capable of describing and explaining the process of IMM based on its traces within socio-technical systems. The achievement of this goal will establish the ground for the implementation of (intelligent) support services later on: e.g., visualization of conflicts, showing differences between the understanding of the user and the collective, navigating through collaboration histories in AAN and/or recommendations of crucial learning materials. These services include (perceived) affordances, which are qualities of objects that suggest how they might be used [6]. The most meaningful combinations of both will be realized as part of the Learning Layer's software solution, will reveal the manifold process of IMM and thus, will lead to an elevated and shared understanding between the users and their domain. Exemplarily, two potential support services will be sketched in the light of two current designs for the health care sector in the UK.
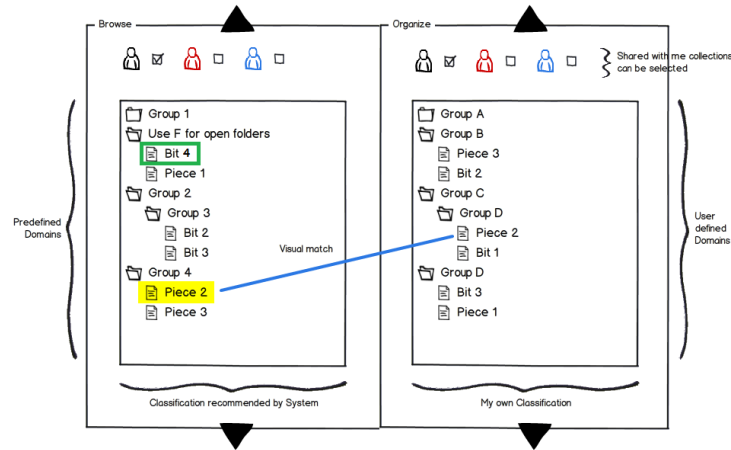

Fig. 1. Differences between individual and collective understanding (B&P)

Example 1 - Visualization of discussions and their evolution: There are guidelines to handle certain situations and diseases (e.g., Diabetes) spread by the National Health Service. These guidelines have to be followed and adapted by General Practitioners (GPs), Diabetes Specialist Nurses, etc. to be able to deliver the best care to locals with corresponding needs. Frequently, particular passages remain unclear, need to be interpreted and trigger discussions at those points (LL Design Team "Pandora"). Thereby, intensive IMM emerges. Visualizations of the critical passages and the corresponding history of IMM could elevate the shared understanding of (to be) involved staff to efficiently resolve existing ambiguities in collaboration.

Example 2 - Visualization of differences between the individual and the collective: Health care employees (e.g., GPs, nurses & health care assistants) are usually under great time pressure while managing their daily work (LL Design Team "Bits & Pieces" (B&P)). Remembering important experiences represents a challenge, because of heavy restriction regarding confidentiality and its protection. Quick (symbolic) representations and the affordance to visually make sense of them afterwards are needed. Thereby, the stimulation of IMM would provide essential support and could be realized by revealing differences between the individual and collective understanding and raising the respective awareness: e.g., highlighting of the most helpful documents of the collective (green - recommendation of "Bit 4", which is not part of the own collection) or emphasizing different categorization approaches of the collective (yellow - while "Piece 4" is categorized in "Group D", the collective sees it in "Group 4" - see Figure 1).

2 Theoretical Background

Distributed Cognition (DC) [5] assumes that social organization is a form of cognitive architecture and determines the way information flows in the context of activity. Therefore, distributed cognitive systems such as contemporary AANs can be analyzed in terms of how knowledge is distributed across the system of actors, artifacts and actor-artifact-relations. In particular, the distribution occurs in three ways: i) in relationships between members of a social group, ii) in interactions between internal (mental) and external representations and iii) in a development over time [4]. However, DC remains still vague in terms of describing these socio-cognitive processes, which is why this dissertation will additionally pull up different more detailed approaches. Again, they do have certain strengths in explaining either more formal or more theoretical aspects of these cognitive processes, but are all limited in some respect.

First, the co-evolution model [2][7] is raised, which describes the interaction of internal and external knowledge representations as a form of co-evolution between the cognitive (user) and social system (social media). It assumes that both systems influence each other by the two processes of internalization and externalization. Thereby, the model draws upon schema theory and the ideas of Piaget [8] to precisely analyze the underlying learning mechanism in both systems and their influence on knowledge representations. In this way, the model theoretically specifies collaborative knowledge construction and the corresponding interplay of a user with social media. But unfortunately, the model constrains its analysis to single articles and misses to come up with an adequate formalization of involved mental categories and their evolution. Fu and Dong's [3] model can be used to fill this gap. They present an approach to stochastically model knowledge exploration with respect to social tagging. Again, the authors somewhat ground their ideas on Piaget [8] to predict the development of mental categories based on the users' indexing behavior. Thereby, they nicely refer to the construct of meaning making on AAN level, but restrict their analysis to one single kind of

interpretation, namely social tagging, and ignore manipulation of tags such as renaming, merging or deleting.

Yet, both approaches miss out to put their ideas in the nowadays necessary collaborative context. This can be addressed by utilizing the thoughts of Suthers [12] on intersubjective meaning-making, which shed more light on collaborative learning interactions and their necessities or outcomes, respectively. According to Suthers [11] the interactions have to be analyzed with respect to uptake indicators for IMM. These indicators are contained in the sequence of actions, an individual takes on a digital artifact: e.g., revising a passage in a wiki article instead of simply adding a new one, pointing out to the adequate more capable peer by deixis instead of randomly asking for help or annotating a certain point in a picture instead of multiple revisions to find the right position. By introducing the uptake graph Suthers provides a graphical as well as conceptual formalization of the practices of meaning making: i.e., "how people in groups make sense of situations and of each other" [12]. AAN are able to reflect these practices within the collaboration history, because they create more meaningful semantic connections between artifacts and actors [9]. Thus these connections also represent the traces of IMM and can be exploited in this respect by looking at the log files captured in e.g., the SSS.

3 Research Questions

The planned dissertation will examine the following three research questions, to shed more light on the process of IMM, validate the insights and come up with adequate support:

– Can the process of IMM be described and explained by an integrated model through combining more theoretical and more formal approaches of cognitive psychology?
– Can this integrated model be empirically validated in different settings by the means of achieving a higher correspondence of the cognitive and the social system and a shared understanding respectively?
– How can these insights be used to develop support services including appropriate affordances to support the process of IMM in socio-technical systems?

4 Method

This dissertation will follow the suggestions of Hollan et al. [4] by conducting an iterative methodological triangulation of ethnography, design and experiment in the light of DC, which the authors propose in their integrated research activity map: i.e., the planned theoretical model, corresponding methods and final products will be approximated from different methodological perspectives in recurring feedback cycles to achieve the research objective of understanding and supporting IMM in all of its facets. Hence, this dissertation will make use of a variety of qualitative and quantitative methods to examine related processes.

For this purpose, the integrated model will be designed based on literature work comprising of a visual representation of IMM and a process description defining its single steps. At the same time the literature review serves the need to distinguish IMM from other similar concepts, such as sense making, or to decide about their inevitable combination. Further on, the model will be iteratively refined and enriched by the insights gained in (field-) studies. On the one hand, these studies will be conducted by qualitative analysis of realistic work practices to elaborate on the designed model and to elicit the necessary context for the uptake of meaning. Therefore an analysis of corresponding situations and materials will be conducted in co-design workshops by e.g., the mean of graphical elicitation methods describing IMM processes and their necessities. Subsequently, the context will be classified into categories of different degree of formality and sharedness necessary to take up the meaning: e.g. a discussion of two GPs about a unknown phenomenon requires a shared understanding of the issue alongside formal categories (highly shared), such as a international classification of diseases, drug classification and location, but also half formal ones (at least partly shared), such as symptom description, side effect and surrounding (B&P). On the other hand, qualitative analysis of existing socio-technical systems will be administered to break down the available services, included affordances and their basis, the entities (e.g. tags, contents, use histories), useful for IMM. Afterwards they can be mapped onto the single steps of the integrated model to understand the most helpful combination of IMM steps, entities and affordances in support services. This mapping will help to find out about the missing pieces and to exploit the nowadays technical capabilities in a meaningful way. Informed by these combination the corresponding valuable logs can be pooled to automatically monitor the underlying process. Finally this entire procedure will lead to the clarification of the first research question. The thereof inferred model will be transferred into assumptions and hypotheses, which will be tested in controlled (field-) experiments in different settings later on: e.g., data mining of log files of the SSS to monitor the social system and administration of association tests with users to monitor the cognitive systems enable the quantitative analysis of predictions regarding the correspondence of both systems. This will be done with the goal to find out about second research question. Finally the achieved insights of the first two research questions will be exploited to improve old or design new support services including appropriate affordances, which are capable of selectively supporting certain steps of the IMM process. This will elevate the shared understanding and thus enable efficient collaborative knowledge construction.

5   Discussion

The dissertation's motivation of socially analyzing collaboration and its drivers is based on the work of Stahl et al. [10] who provide a historical perspective on Computer Supported Collaborative Learning. Therein, they claim that theorizing about mental models in individuals' heads does not help, because they are not capable of capturing intersubjective meaning construction. However, the

analysis of mental models in comparison to the collective representation is helpful to analyze meaning making [1][3]. In this way, mental models can be used not to see what the individual has learned, but if the given social support functionality was able to actually facilitate the process of IMM: i.e., to examine if a certain visualization was helpful to achieve a shared understanding in triggering the desired kind of learning mechanism. Additionally, it is important not to limit IMM to one single kind of interpretation. It is essential to take all manifold variations of IMM into account namely all manipulations of each available representations. Hence, the unit of analysis will not be constrained to article level, but rather all units of AANs including affordances for IMM and corresponding logs will be considered: e.g., documents, discussion, pictures, videos, links, tags & persons.

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