Improving Online Collaboration by Fostering Norm-Oriented Content Based Knowledge Awareness

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Abstract: In transient online groups, fostering awareness about the content of the partners' knowledge from the outset has been shown to facilitate collaboration. A common problem, however, is lack of compatibility of individually designed knowledge representations. To address this problem, in the current study collaborators were given insight into each other's representation construction processes. As expected, the thus generated normalized representations facilitated the interaction.

The Benefits and Challenges of Online Collaboration

The modern convenience of being able to work or learn collaboratively over long distances bears challenges as well as advantages. For example, according to the information sampling model (Stasser & Titus, 2003) groups tend to discuss information that is shared by all group members, whilst neglecting information that is unshared. It is easy to see then how in a transient group collaborating over long distance crucial information might be neglected and lost; the result being an inferior group effort. In addition, groups need time to establish who knows what in the group, i.e. to develop a transactive memory system (Wegner, 1986), so that in many cases the coordination of (mental) labor in the transient online group can be messy, in particular in the early phases of the collaboration.

Content Based Knowledge Awareness

The Content based Knowledge Awareness approach (CoKA, formerly known as Knowledge and Information Awareness, KIA) has shown promise in ameliorating these problems (Engelmann, Tergan, & Hesse, 2010). By giving collaborators insight into each other's knowledge content, the approach aims to raise awareness of the entirety of knowledge available to the group so that the chances of unshared knowledge being neglected are reduced (Engelmann & Hesse, 2011). Moreover, through having insight into the collaborators' knowledge content (e.g. summarized in a diagram), group members have an easier time figuring out who knows what; a transactive memory system can thus be quickly established (Schreiber & Engelmann, 2010).

While several studies (Engelmann et al., 2010; Engelmann & Hesse, 2011; Schreiber & Engelmann, 2010) demonstrate the benefits of providing CoKA, there is the challenge that incompatibilities in knowledge representations tend to emerge when collaborators generate their knowledge summaries individually (e.g. Engelman & Kolodziej, 2012). In order to circumvent this problem, in the current study group members were provided not only with insight into each other's knowledge but also into each other's knowledge representation generation process. It was anticipated that the resulting knowledge representations would be more compatible and effective in fostering CoKA. This in turn should promote effective collaboration.

Method

The participants in this study were 120 (94 female, 36 male) University of Tübingen students, mean age 23.7 (SD = 2.9) who participated for payment. They were grouped into triads. Gender composition of the triads was controlled across conditions; aside from this, condition assignment was random.

Knowledge content representations were generated in the form of concept maps (Novak & Gowin, 1984). All participants received training in using CmapTools, an online tool for concept map creation. The collaborative task was to find the ideal pesticide and the ideal fertilizer for a fictitious type of spruce forest being threatened by several fictitious pests. This fictitious scenario was chosen to prevent a potential influence of the participants' prior knowledge. The scenario featured 13 concepts (e.g. building spruce, material bug) linked amongst each other by 30 relations (e.g. material bug *severely damages* the building spruce).

Each participant in a triad received a list of 12 sentences. These sentences represented that participant's expert knowledge on the issue. Overlaps in knowledge between participants were kept minimal. Each sentence described two concepts (out of the 13) and a link between them. If transformed into an appropriate concept map representation and combined with the expert knowledge of the other triad members the overall 36 sentences shared between the collaborators would reveal the ideal solution for the spruce forest problem.

During an individual phase, participants in the control condition were tasked with creating a concept map of their expert knowledge. Subsequently, in a collaborative phase, the participants had to pool their

individual knowledge, generating a joint concept map and solve the spruce forest problem. Importantly, at no point did the triad members in the control condition have access to the others' individual concept maps. In contrast, participants in the experimental condition were able to view the other group members' maps during the silent individual phase as well as later during the collaborative phase. They thus had CoKA.

Results

As hypothesized the individual concept maps in the CoKA condition were more compatible than in the control condition. Three different measures corroborated this. In the CoKA condition individual group members had less variation in number of correctly depicted concept nodes (CoKA: 1.459, Control: 2.282) and less variation in number of correctly depicted relations (CoKA: 1.961, Control: 3.387). Both these differences were significant: *Welch's t* (29.63) = 2.12, $p < .05$ and *Welch's t* (27.40) = 2.87, $p < .05$, for number of correct concepts and number of correct relationships, respectively. The third measure was node centrality: In each concept map, a centrality rank was assigned to each concept node. The higher the number of relations emanating from a concept the higher its centrality rank. If participants in a group had similar standards for concept map creation, then they should have more agreement about the centrality of the concepts from the same category. Thus their centrality rankings should be correlated. Indeed, the centrality rankings within the CoKA group were more correlated than the centrality rankings within the control group (Average Z-standardized correlation coefficients for CoKA: 0.151, Control: 0.029). This difference was significant, *Welch's t* (36.12) = 5.07, $p < .05$.

Regarding the hypothesis that CoKA with prior insight into the group members' concept map construction process, it was found that the degree of variability of maps within the groups, as measured by the standard deviation in the number of correct nodes and the deviation in the number of correct relationships, is negatively related to group efficiency in the CoKA condition ($r = -0.42$; $p = .07$ and $r = -0.50$; $p < .05$, for correct nodes and correct relationships, respectively). This means that groups in the CoKA condition found a correct solution faster when compatibility of their concept maps was high. No such relationship was found in the control condition ($r = -0.23$; n.s. and $r = -0.08$; n.s., for correct nodes and correct relationships, respectively).

Discussion

The results of this study indicate that giving collaborators insight into each other's knowledge representation construction does indeed result in more compatible knowledge representations being created. This compatibility exceeds simple concept overlap and includes the actual form of the representations. While the data is still being analyzed, preliminary results indicate that having more compatible knowledge representations of the collaborators benefits group performance on the task. This is in line with previous results where participants were *a priori* provided with compatible knowledge representations and their task performance improved (e.g. Engelmann et al., 2010).

The results of this study further support the CoKA approach as a valid tool to facilitate transient interactions between spatially distributed collaborators. The insight into the partners' knowledge that collaborators using this approach gain at the outset of their interaction permits, amongst others things, a quick establishment of a transactive memory system (Schreiber & Engelmann, 2010). Having an overview of the knowledge available to the group also makes it less likely that unshared information will be ignored (Engelmann & Hesse, 2011). The present study further increases the ecological validity of the approach, showing that with insight into each other's knowledge representation creation, collaborators are capable of creating sufficiently compatible knowledge representations, which can foster CoKA and thus improve the collaborative effort.

References

Engelmann, T. & Hesse, F. W. (2011). Fostering sharing of unshared knowledge by having access to the collaborators' meta-knowledge structures. *Computers in Human Behavior, 27*, 2078-2087.

Engelmann, T. & Kolodziej, R. (2012). Do virtual groups recognize situations in which it is advantageous to create digital concept maps? In A. Cañas, J.D. Novak. & J. Vanhear (Eds.), *Concept Maps: theory, methodology, technology. Proceedings of the 5th International Conference on Concept Mapping* (Vol. 1, pp. 172-179). Malta: University of Malta.

Engelmann, T., Tergan, S.-O. & Hesse, F.W. (2010). Evoking KIA for enhancing computer-supported collaborative problem solving. *The Journal of Experimental Education, 78*, 1-20.

Novak, J. D. & Gowin, D.B. (1984*). Learning how to learn.* New York: Cambridge University Press.

Schreiber, M. & Engelmann, T. (2010). KIA for initiating transactive memory system processes of computer-supported collaborating ad hoc groups. *Computers in Human Behavior, 26*, 1701-1709.

Stasser, G. & Titus, W. (2003). Hidden profiles: A brief history. *Psychological Inquiry, 14*, 304-313.

Wegner, D. M. (1986). Transactive memory: A contemporary analysis of the group mind. In B. Mullen & G. R. Goethals (Eds.), *Theories of group behaviour* (pp. 185-208). New York: Springer.