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Sharing Emotions Impacts Computer-Supported Collaborative Processes: Effect of an Emotion Awareness Tool

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There is a large consensus among researchers on the significant role of emotions in group effectiveness and performance. Emotion awareness tools (EATs) have been developed in recent years allowing members of a group to identify with their own- and their partner's emotions through a computer-mediated collaboration. In this study, we report the impact of an EAT on socio-cognitive and relational processes, and its differential effect depending on gender. This study shows that the EAT was beneficial for processes contributing to the quality of working relationships and the mutual modeling process, by which group members gain a better awareness of their partner's knowledge.

1. Introduction

Roschelle and Teasley defined collaboration as "a coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem" (Roschelle & Teasley 1995: 70). In the Computer-Supported Collaborative Learning (CSCL) field, it is well accepted that the success of collaboration depends on the occurrence of specific forms of social interactions, namely constructive and productive interactions such as processes by which collaborative partners a) construct and update a shared understanding (*grounding*; Dillenbourg, Traum, & Schneider 1996), b) collect relevant problem-based information from each other (*knowledge elicitation*; Cooke 1994), and c) build on their respective contributions to the problem (*transactivity*; Berkowitz & Gibbs 1983).

However, working together does not always guarantee better learning gains. Even if teamwork can contribute to improved performance, it can sometimes have the opposite effect, degrading performance and discouraging learners. Barron (2003) showed that quantitative variables like the group's prior knowledge, the number of turns, and even the number of correct ideas generated during interaction are not sufficient to explain differences between groups in terms of problem-solving scores. She pointed out that more subtle variables like how learners react to their collaborative partners' proposals (by accepting/discussing or conversely rejecting/ignoring them) are more significant to consider when explaining the underperformance of groups with similar characteristics at the cognitive level. Barron therefore claims that there is a need to understand collaboration as a dual-problem space, where participants must

engage with each other in the development of both a cognitive space (solving the problem itself) and a relational space (maintaining a positive and motivating working relationship; see also Andriessen, Baker, & van der Puil 2011). Based on Barron's (2003) dual-space model, the present study investigates interactive processes that occur during a computer-supported collaborative design task, and focuses on both cognitive and relational aspects.

This study also concerns the sharing of emotions in remote collaboration. Collaboration is a challenging and demanding task, and people continuously experience and express (either verbally or non-verbally) positive and negative emotions when working towards a common goal. The relations between emotions and cognition, more specifically reciprocal linkages between emotions, learning processes, strategies, and outcomes are currently well documented. For example, Pekrun (2006) demonstrated that the learners' positive emotions like enjoyment relate positively to the self-regulation of learning and academic achievement, whereas negative emotions like boredom relate negatively to processes and outcomes. Improving our understanding and further addressing the role of emotions in collaborative settings is still a necessity, predominantly their effects on both cognitive and relational processes of collaborative learning.

In recent years, a growing interest in this research topic has emerged. Formerly research focused specifically on the role of emotional expression during face-to-face interaction. Previous research showed that expressing positive emotions such as happiness increases the approach behavior, promotes interpersonal trust, affiliation, group cohesion and cooperation (Barsade 2002; Fredrickson & Branigan 2011; Kelly & Barsade 2001). In contrast, negative emotions such as anger provoke avoidance behavior, reduce cooperation and can have a detrimental effect on group performance (Van Kleef, Dreu, & Manstead 2010). Rimé (2015) also found that individuals may benefit from sharing their emotions with others because it allows them to better understand themselves and makes them feel accepted by others. Finally, there is also research that focuses specifically on the divergences of emotion-related processes between women and men. Women are more likely to express their emotions, and score higher than men on measures of social sensitivity (Kring & Gordon 1998; Woolley, Chabris, Pentland, Hashmi, & Malone 2010).

A large variety of verbal strategies combined with nonverbal and paralinguistic mechanisms (e.g. facial expressions, gestures, tone of voice) can be used to express emotions. The access to these non-verbal cues is limited in remote computer-supported collaboration (CMC). Such a limitation may be detrimental to the mutual awareness and understanding of emotions experienced during interaction. Furthermore, discrepancies between expressed and perceived emotions are more frequently observed in CMC settings. These may provoke negative feelings and be detrimental to the partner modeling process and the collaboration experience (Gauducheau 2008). Two studies by Eligio, Ainsworth

and Crook (2012) specifically investigated the effect of sharing emotions in CMC settings among women participants. The results of the first study highlight the difficulty of computer-mediated collaborators in accurately assessing their partner's emotions. In the second study, results show that being made aware of the partner's emotions may positively impact group climate and performance. This study leads to the hypothesis that *emotion awareness tools* (EATs) can be viewed as a technological solution in improving the mutual modeling of emotions in a group. EATs are part of *Group Awareness Tool* (GATs; Buder, 2011), systems that provide users with real-time and/or retrospective feedback on their own- and their partners' activity, which aim at promoting regulation during collaborative tasks (see e.g. Molinari, Sangin, Dillenbourg, & Nüssli 2009; Sangin, Molinari, Nüssli, & Dillenbourg 2011). EATs are exclusively designed to provide collaborators with information about their own emotions, their partner's emotions and/or the group's emotions (Cernea, Ebert & Kerren 2014; Chanel, Bétrancourt, Pun, Cereghetti & Molinari 2013; Feidakis, Daradoumis, Caballé & Conesa 2013; Molinari, Chanel, Bétrancourt, Pun & Bozelle 2013).

In Molinari et al. (2013), participants worked remotely in dyads, where the common goal was to design a slogan against violence in schools. Half of the 30 dyads were provided with an EAT (i.e. the EAT condition compared to a *control* condition without the EAT). Thanks to the EAT, participants could communicate their emotions to their partner using interface buttons corresponding to 10 positive emotions (e.g. interested, satisfied, amused, etc.) and 10 negative emotions (e.g. frustrated, anxious, unsatisfied, etc.) at any time during the collaborative task. The EAT also offered them the possibility to simultaneously visualize their own emotions and that of their partner during the interaction. The effect of the EAT was investigated on the perceived quality of collaboration. More precisely, a 57-items questionnaire was used to measure the way participants perceived the interaction with their partner, and an exploratory factor analysis was performed on the obtained responses, to extract underlying factors. Eight factors corresponding to 8 collaborative dimensions were found: (1) mutual understanding, (2) conflict management, (3) interpersonal convergence, (4) co-construction, (5) confrontation of points of view, (6) communication of emotions, (7) mutual modeling of emotions and (8) transactivity. Analyses of variance were conducted to investigate the main effect of the EAT and its interaction with gender on each collaborative dimension. A positive main effect was found on the mutual modeling of emotions. The tool motivated the participants to compare between their own emotional state with that of their partner. This also led them to understand and anticipate their partner's behavior based on the emotional response received. In other words, the value of the EAT lies in promoting both emotion awareness and emotional perspective taking. A positive relation was also observed in the EAT condition between the mutual modeling of emotions and the perceived degree of transactivity, that is, the time spent building on the partner's ideas. Finally, results also showed that the effect of the EAT on the perceived transactivity

varied based on gender. The EAT led to a significant increase in transactivity for women (EAT > control), whereas it led to a decrease for men (this decrease was non-significant). For women, expressing and receiving emotions would have the effect of encouraging them to reason using ideas obtained from their partner. In contrast, it would have generated discomfort and an extra-cognitive load in men (Swaab & Swaab 2009).

2. Research Questions and Hypotheses

The verbal interaction data collected from the Molinari et al. (2013) study described above is analyzed. The aim is to further understand how the EAT may shape participant interaction between each other on both the cognitive and relational sides. We also investigate how the effect of the EAT on collaboration processes may vary based on gender. We approach these questions from an exploratory approach, where our main hypotheses are as follows: 1) the EAT modulates the use of some interactive processes, in particular those involving the modeling of the partner and his/her emotions (H1); 2) there are differences between women and men with respect to the use of some collaborative processes irrespective of the use of the EAT (H2); 3) the EAT differently impacts the use of some collaborative processes by men and women, especially in terms of transactivity processes (H3).

3. Method

3.1 Participants, Experimental Conditions and Collaborative Task

The verbal interaction analysis presented in this paper was performed on a sample of 38 participants (24 women and 14 men; *M* = 24.05 years, *SD* = 9.55) taken from the study of Molinari et al. (2013). This sample is smaller than the total sample (60 participants working in 30 same-gender dyads) due to technical issues when recording the dyads' verbalizations. Twenty-two participants were in the EAT condition (12 women/6 dyads and 10 men/5 dyads) and the remaining 16 participants in the Control condition (12 women/6 dyads and 4 men/2 dyads). The asymmetry in the number of women and men dyads in the Control condition needs to be considered when interpreting the obtained results.

All dyads performed a remote collaborative design task. They were asked to co-create a violence prevention slogan using the DREW argument graph tool (Lund, Molinari, Séjourné, & Baker 2007). The task was divided into 3 steps: 1) "brainstorm" as many slogan ideas as possible; 2) evaluate each slogan based on 4 criteria (persuasive, original, suited to audience, emotional appeal); 3) select the best slogan. The participants communicated with each other through microphone headsets during the task, and their verbal exchanges were recorded. In the EAT condition, the dyad members were invited to use the EAT for sharing their emotions at any time during the interaction. The EAT was

composed of three parts, one for the self-assessment of emotions, one for the visualization of the participants' own emotions and one for the visualization of their partner's emotions. A complete description of the task and a picture of the EAT can be found in Molinari et al. (2013).

3.2 Analysis of Collaborative Verbal Acts

3.2.1 Coding Scheme

Our coding scheme was designed to focus on the cognitive and relational processes described in Barron's (2003) *dual-space* model of collaboration. It is composed of 7 categories (C1-Outside activity; C2-Social relation; C3-Interaction management; C4-Information sharing; C5-Transactivity; C6-Task management; C7-Tool discourse). As depicted in Table 1, categories C2 to C5 were also divided into sub-categories (4 for C2; 7 for C3 and C4; 8 for C5 for a total of 26 sub-categories).

Four out of the seven categories (C1, C2, C3 and C6) come from the RAINBOW model for the analysis of computer-mediated pedagogical debates (Baker, Andriessen, Lund, van Amelsvoort & Quignard 2007). In the RAINBOW model, C2 and C3 are considered as non-task focused communicative acts. Specifically, C2 consists of acts that contribute to the circulation of task-related emotions between partners, whereas C3 consists of acts to keep the dialogue on track. Furthermore, some subcategories of C2 and C3 refer to group processes from the positive (show solidarity, agree) and negative (show hostility, disagree) socio-emotional areas in Bales' (1950) Interaction Process Analysis (IPA). *Relax atmosphere* and *use social convention* (subcategories from C2) are also part of the affective and cohesive categories in the social presence coding scheme described in Hughes, Ventura and Dando (2007). C4 to C6 refer to socio-cognitive acts involved in the problem resolution process, and were defined based on other coding schemes (Meier, Spada, & Rummel 2007; Noroozi, Teasley, Biemans, Weinberger, & Mulder 2012). C4 and C5 describe specific acts recognized as playing a crucial role for learning, namely acts used to gain awareness about a partner's knowledge (e.g. elicit partner-information), to build a shared understanding (e.g. give explanation), to engage in transactive discussion (e.g. contradict, incorporate) and argumentation (e.g. give opinion against). The coding scheme we obtained provides a functional classification (each category is related to a process) covering a large amount of exchanges.

	Sub-categories	Examples
C2	Show solidarity	We are a good team!
	Show hostility	We are too bad!
	Relax atmosphere	Oh, I'm not sure they'll understand what we did there (laughs)
	Use social convention	Nice to meet you!
C3	Check reception	Can you hear well?
	Check comprehension	*Do we have to write this in a new box? What box?*
	Show active listening	Hm hm; Yes…
	Show hesitation/reflection	Um…/eeh…; Maybe we can…
	Coordinate teamwork	Do you take notes? I think about that during that time
	Agree	*Can you write this?* Yes, ok
	Disagree	*Ok, I take notes.* Eeh no, I prefer doing that
C4	Give task-information	Actually, the goal is to sensitize the teenagers not the parents
	Give explanation	Actually, I meant that perhaps it's more persuasive like that
	Elicit task-information	Violence, with what it rhymes?
	Give self-information	I didn't remember why I said that
	Elicit partner-information	Have you ever done tasks like that?
	Give recall	*What did you say?* I said: Be stronger than violence
	Elicit recall	What did you tell me about that already?
C5	Give proposition	I have thought about something like: All our children are concerned, stop violence!
	Give opinion for	*But we have to say the word violence?* Yes or we can suggest it
	Give opinion against	*It's better if it's short to be persuasive?* No, I think the size is not very important
	Elicit proposition	Do you have some ideas or not?
	Elicit opinion	I like this slogan,what about you?
	Accept	Ok, I agree with your ideas
	Contradict	I'm sorry but our slogan have to target teenagers not parents
	Incorporate	*I have thought about something like: All our children are concerned, stop violence!* Ok, we have the persuasive side but it's not very original. Maybe, stop violence, it's up to all of us!

Table 1: Subcategories for Social Relation (C2), Interaction Management (C3), Information Sharing (C4) and Transactivity (C5) with Examples. (Examples in italic refer to what has been said previously by the other partner for a better comprehension)

3.2.2 Coding Procedure

For each dyad, the whole verbal interaction content was first transcribed with the ELAN software (Sloetjes & Wittenburg 2008). Pauses and turn-taking served as a basis for segmenting the verbal interaction into collaborative units. Two independent coders were trained to apply the coding scheme previously described. They were provided with the verbal transcriptions combined with audio (voice) and video (face) recordings of the dyad members. The verbal interactions of all the dyads were analyzed by a first coder, while the second coder oversaw the coding interactions of only 10 dyads. The inter-coder reliability of Cohen's kappa was equal to 0.47. This moderate agreement (Viera & Garrett 2005) may be because it is calculated based on a high number of subcategories. Another explanation is that reliabilities across categories are not homogeneous. We found substantial agreements (from 0.62 to 0.73) for the *Information sharing*, *Interaction management, Transactivity* categories and moderate agreements (from 0.52 to 0.53) for the *Task management*, *Tool discourse, Social relation* categories. Therefore, results from categories with moderate inter-coder reliability must be interpreted carefully.

4. Results

The coding scheme was applied to 4580 units in the EAT condition and to 3750 units in the Control condition (a mean of 219 units per participant). A series of 2 (EAT) x 2 (Gender participant) ANOVAs was performed on the use rate for each type of collaborative process, which was calculated as the proportion of units of each subcategory out of the total number of units that had been coded.

The EAT had a positive main effect for the *Use social convention*, *Give self-information* and *Elicit-partner information* processes (Table 2). Specifically, the use rate was higher in the EAT condition than in the Control condition for *Use social convention* ($F(1, 34) = 4.75$, $p = .003$, $\eta^2 = 0.12$), *Give self-information* ($F(1, 34) = 6.92$, $p = .012$, $\eta^2 = 0.16$) and *Elicit partner-information* ($F(1, 34) = 5.43$, $p = .002$, $\eta^2 = 0.13$). The EAT also presented a negative effect for *Coordinate teamwork* with a higher use rate in the Control condition than in the EAT condition ($F(1, 34) = 3.85$, $p = .057$, $\eta^2 = 0.10$; see Table 2).

	EAT condition	Control condition
Use social convention	*M* = 0.96, *SD* = 0.56	*M* = 0.52, *SD* = 0.60
Give self-information	*M* = 4.71, *SD* = 2.54	*M* = 2.89, *SD* = 2.24
Elicit partner-information	*M* = 0.81, *SD* = 0.12	*M* = 0.36, *SD* = 0.57
Coordinate teamwork	*M* = 2.04, *SD* = 1.59	*M* = 2.89, *SD* = 1.28

Table 2: Mean Use Rates and Standard Deviations for the *Use Social Convention*, *Give Self-Information*, *Elicit Partner-Information* and *Coordinate Teamwork* Subcategories in the EAT (with the Emotion Awareness Tool) and Control (without the Emotion Awareness Tool) Conditions.

Gender had a main effect on four processes (see Table 3). The use rate was higher for women than for men for three out of four processes, namely: *Show solidarity* ($F(1, 34) = 4.81$, $p = .035$, $\eta^2 = 0.12$), *Give recall (*$F(1, 34) = 12.00$, $p = .001$, $\eta^2 = 0.26$) and *Tool discourse* ($F(1, 34) = 5.21$, $p = .028$, $\eta^2 = 0.13$). On the other hand, men had a higher use rate than women for *Give proposition,* $F(1, 34) = 8.64$, $p = .005$, $\eta^2 = 0.20$.

	Women	Men
Show solidarity	*M* = 0.70, *SD* = 0.78	*M* = 0.20, *SD* = 0.35
Give recall	*M* = 4.06, *SD* = 1.8	*M* = 1.99, *SD* = 1.76
Tool discourse	*M* = 7.09, *SD* = 5.92	*M* = 3.47, *SD* = 2.25
Give proposition	*M* = 6.18, *SD* = 3.16	*M* = 9.23, *SD* = 4.28

Table 3: Mean Use Rates and Standard Deviations for the *Show Solidarity*, *Give Recall*, *Tool Discourse* and *Give Proposition* Subcategories for Women and Men.

The EAT by Gender interaction was significant for *Relax atmosphere* ($F(1, 34) = 6.59$, $p = .014$, $\eta^2 = 0.16$) and *Give opinion against (*$F(1, 34) = 7.65$, $p = 0.009$, $\eta^2 = 0.18$) (Table 4). Post-Hoc tests showed that men produced more *Relax atmosphere* acts and fewer *Give opinion against* acts in the EAT condition than in the control condition. By contrast, the EAT did not influence the use of the *Relax atmosphere* and *Give opinion against* acts for women.

		EAT condition		Control condition
Men	Relax atmosphere	*M* = 6.35, *SD* = 3.35	>*	*M* = 0.92, *SD* = 1.16
	Give opinion against	*M* = 0.92, *SD* = 1.26	<**	*M* = 3.43, *SD* = 1.05
Women	Relax atmosphere	*M* = 4.75, *SD* = 2.96	≈	*M* = 4.20, *SD* = 2.27
	Give opinion against	*M* = 1.52, *SD* = 1.14	≈	*M* = 1.55, *SD* = 1.06

Table 4: Mean Use Rates and Standard Deviations for the *Relax Atmosphere* and *Give Opinion Against* Subcategories for Women and Men in the EAT and Control Conditions (*p<.05; ** p<.01).

5. Discussion and Conclusion

The goal of this study was to understand the impact of using an *emotion awareness tool (*EAT), capable of providing methods for sharing emotions during a computer-supported collaborative effort, on the cognitive and relational dimensions of collaboration.

First, results showed that on the one hand, the EAT increased the use of relational acts (*use social convention*) that contribute to intragroup dynamics such as group formation and group cohesion, which participate in the maintenance of social presence (Hughes et al. 2007). On the other hand, the EAT positively impacted the use of socio-cognitive acts such as *Give self-information* and *Elicit partner-information* that correspond to mutual modeling processes enabling the participants to gain a higher awareness of their partner's knowledge (Sangin et al. 2011; Molinari et al. 2009). These results are consistent with H1.

Second, we found that encouraging the dyad members to focus on their respective emotions negatively impacted the use of coordination processes. The reason for this may be twofold. The negative effect on *Teamwork coordination* might relate to the specific tool constraints, rather than the emotion sharing process itself. For instance, one may expect participants to struggle in selecting (from the lists) the specific emotion label that ideally represents their feeling, while at the same time performing the task. Another explanation may be that a more efficient method of sharing personal information between partners in the EAT condition could potentially lead to lesser interpersonal coordination.

Third, consistent with H2, some collaborative processes were used differently between men and women irrespective of the use of the EAT. The women showed more solidarity towards their partner in comparison to the men. This is consistent with previous research, where women have been found more likely to use verbal expression to give or seek emotional support than men (Tamres, Janicki, & Helgeson 2002). Furthermore, the women were more inclined to

repeat what was already expressed during interaction (*Give recall*) and therefore more likely to refine ideas and consolidate their common ground. Contrarily, the men focused more on providing new ideas (*Give proposition*). Therefore, results suggest that men and women differ on how they use relational and socio-cognitive processes. The women showed more positive socio-emotional behavior. They also tended to work together to achieve the task guided by a strategy of deepening existing ideas, while the men were more likely to follow the strategy of externalizing new ideas. Overall, these results suggest that compared to men, women tend to collaborate in a more transactive way, at both the emotional and cognitive levels.

Finally, the EAT encouraged the men to interact with their partner in a more friendly and relaxed way, discouraging them from arguing against and modifying their partner's ideas. In other words, the possibility for men to share emotions during interaction positively impacts the quality of the relationship with their partner. However, this relational benefit appears to be counterbalanced by a greater difficulty for men in engaging in argumentative interactions. This result is consistent with H3 and with previous findings (Molinari et al. 2013) that showed a negative (but non-significant) effect of the EAT on the perceived transactivity for men. One may thus assume that prompting men to focus on emotions when interacting would be in opposition with their tendency to behave in competitive and assertive ways during negotiations (Mazei, Hüffmeier, Freund, Stuhlmacher, Bilke, & Hertel 2015). By contrast, there was no significant effect of the EAT on the way the women collaborate with each other on both the relational and cognitive planes. Since it tends to be easy for women to identify and communicate feelings (Kring & Gordon 1998), one may assume that they do not need technological support to effectively manage emotional information during collaboration. Despite this non-significant finding, one can however note that the EAT positively affected the women's perception of the quality of the interaction with their partner, specifically the extent to which they engaged in transactive discussions (Molinari et al. 2013). It is noteworthy that these gender results should be interpreted with caution due to the small number of men dyads used in the verbal interaction analysis. Limitations of our study also include the moderate intercoder reliability for the social relation dimension. Despite this, our results tend to support the hypothesis of a beneficial effect of an emotion awareness tool on relational and socio-cognitive processes. They also improve our understanding of emotions and its role in computer-supported collaborative learning/problem-solving, providing guidelines in the development of affective collaborative e-learning systems.

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BIBLIOGRAPHY

Andriessen, J., Baker, M. & van der Puil., C. (2011): Socio-cognitive tension in collaborative working relations. In S. Ludvigsen, A. Lund, I. Rasmussen & R. Saljo (eds.), Learning across sites: new tools, infrastructures and practices. London (Routledge), 222-242.

Baker, M., Andriessen, J., Lund, K., van Amelsvoort, M., & Quignard, M. (2007): Rainbow: A frame-work for analysing computer-mediated pedagogical debates. International Journal of Computer-Supported Collaborative Learning, 2(2-3), 315-357.

Bales, R. F. (1950): A set of categories for the analysis of small group interaction. American Sociological Review, 15(2), 257-263.

Barron, B. (2003): When smart groups fail. The journal of the learning sciences, 12(3), 307-359.

Barsade, S. G. (2002): The Ripple Effect: Emotional Contagion and Its Influence on Group Behavior. Administrative Science Quarterly, 47(4), 644.

Berkowitz, M. W., & Gibbs, J. C. (1983): Measuring the developmental features of moral discussion. Merrill-Palmer Quarterly 29(4), 399-410.

Buder, J. (2011): Group awareness tools for learning: Current and future directions. Computers in Human Behavior, 27(3), 1114-1117.

Cernea, D., Ebert, A., & Kerren, A. (2014): Visualizing group affective tone in collaborative scenarios. Proceedings of the Eurographics Conference on Visualization (EuroVis' 14), Poster Abstract.

Chanel, G., Bétrancourt, M., Pun, T., Cereghetti, D., & Molinari, G. (2013): Assessment of Computer-Supported Collaborative Processes using Interpersonal Physiological and Eye-Movement Coupling. Affective Computing and Intelligent Interaction (ACII), Humaine Association Conference, IEEE 2013. 116-122

Cooke, N. J. (1994). Varieties of knowledge elicitation techniques. International Journal of Human-Computer Studies.

Dillenbourg, P., Traum, D. R., & Schneider, D. (1996). Grounding in Multi-modal Task-Oriented Collaboration, 1-14.

Eligio, U. X., Ainsworth, S. E., & Crook, C. K. (2012). Emotion understanding and performance during computer-supported collaboration. Computers in Human Behavior, 28(6), 2046-2054.

Feidakis, M., Daradoumis, T., Caballé, S., & Conesa, J. (2013). Measuring the impact of emotion awareness on e-learning situations. Proceedings - 2013 7th International Conference on Complex, Intelligent, and Software Intensive Systems, CISIS 2013, 391–396.

Fredrickson, B. L., & Branigan, C. (2011). Positive emotions broaden the scope of attention and thought-action repertoires. Cognition & Emotion, 19(3), 1-19.

Gauducheau, N. (2008). La communication des émotions dans les échanges médiatisés par ordinateur: bilan et perspectives. Bulletin de Psychologie, 4, 389-404.

Hughes, M., Ventura, S., & Dando, M. (2007): Assessing social presence in online discussion groups: a replication study. Innovations in Education and Teaching International, 44(1), 17-29.

Kelly, J. R., & Barsade, S. G. (2001): Mood and Emotions in Small Groups and Work Teams. Organizational Behavior and Human Decision Processes, 86(1), 99-130.

Kleef, G. Van, Dreu, C. K. De, & Manstead, A. S. (2010): An Interpersonal Approach to Emotion in Social Decision Making: The Emotions as Social Information (EASI) Model. Advances in Experimental Social Psychology, 42, 45-96.

Kring, A. M., & Gordon, A. H. (1998): Sex differences in emotion: expression, experience, and physiology. Journal of personality and social psychology, 74(3), 686.

Lund, K., Molinari, G., Séjourné, A., & Baker, M. (2007): How do argumentation diagrams compare when student pairs use them as a means for debate or as a tool for representing debate? International Journal of Computer-Supported Collaborative Learning, *2*(2), 273-295.

Mazei, J., Hüffmeier, J., Freund, P. A., Stuhlmacher, A. F., Bilke, L., & Hertel, G. (2015): A meta-analysis on gender differences in negotiation outcomes and their moderators. Psychological Bulletin, 141(1), 85.

Meier, A., Spada, H., & Rummel, N. (2007): A rating scheme for assessing the quality of computer-supported collaboration processes. International Journal of Computer-Supported Collaborative Learning, 2(1), 63-86.

Molinari, G., Chanel, G., Bétrancourt, M., Pun, T., & Bozelle, C. (2013): Emotion feedback during computer-mediated collaboration: Effects on self-reported emotions and perceived interaction. In N. Rummel, M. Kapur, M. Nathan, & S. Puntambekar, S. (eds.), To See the World and a Grain of Sand: Learning across Levels of Space, Time, and Scale: CSCL 2013 Conference Proceedings International Society of the Learning Sciences, 1, 336-343.

Molinari, G., Sangin, M., Dillenbourg, P., & Nüssli, M.-A. (2009): Knowledge interdependence with the partner, accuracy of mutual knowledge model and computer-supported collaborative learning. European Journal of Psychology of Education, 24(2), 129-144.

Noroozi, O., Teasley, S. D., Biemans, H. J. a., Weinberger, A., & Mulder, M. (2012): Facilitating learning in multidisciplinary groups with transactive CSCL scripts. International Journal of Computer-Supported Collaborative Learning, 8.

Pekrun, R. (2006): The control-value theory of achievement emotions: Assumptions, corollaries, and implications for educational research and practice. Educational psychology review, 18(4), 315-341.

Rimé, B. (2015): Le partage sociale des émotions. (Quadridge, Ed.) (2nd ed.). PUF.

Roschelle, J., & Teasley, S. D. (1995): The construction of shared knowledge in collaborative problem solving. ComputerSupported Collaborative Learning, 69-97.

Sangin, M., Molinari, G., Nüssli, M. A., & Dillenbourg, P. (2011): Facilitating peer knowledge modeling: Effects of a knowledge awareness tool on collaborative learning outcomes and processes. Computers in Human Behavior, 27(3), 1059-1067.

Sloetjes, H., & Wittenburg, P. (2008): Annotation by category - ELAN and ISO DCR. Proceedings of the 6th International Conference on Language Resources and Evaluation (LREC'08), 816-820. Retrieved from http://lrec-conf.org/proceedings/lrec2008/pdf/208_paper.pdf

Swaab, R. I., & Swaab, D. F. (2009): Sex differences in the effects of visual contact and eye contact in negotiations. Journal of Experimental Social Psychology, 45(1), 129-136.

Tamres, L. K., Janicki, D., & Helgeson, V. S. (2002): Sex Differences in Coping Behavior: A Meta-Analytic Review and an Examination of Relative Coping. Personality and Social Psychology Review, 6(1), 2-30.

Viera, A. J., & Garrett, J. M. (2005): Understanding interobserver agreement: the kappa statistic. Fam Med, 37(5), 360-363.

Woolley, A. W., Chabris, C. F., Pentland, A., Hashmi, N., & Malone, T. W. (2010): Evidence for a collective intelligence factor in the performance of human groups. Science, 330(6004), 686-688.