How Socio-Cognitive Information Affects Individual Study Decisions

Lenka Schnaubert, University of Duisburg-Essen, lenka.schnaubert@uni-due.de
Daniel Bodemer, University of Duisburg-Essen, bodemer@uni-due.de

Abstract: Metacognitive self-regulation theories assume that individual monitoring guides study decisions. However, self-regulated online learning is not done in isolation and inherently social. Group awareness research suggests that socio-cognitive information may be a strong asset to collaborative and individual learning. Integrating individual research traditions into a social setting, our experimental study ($N = 61$) investigates how visualizing socio-cognitive information influences core individual learning processes, especially the search for information, the learners' self-evaluations of knowledge and learning outcomes. While on the surface study behaviour seemed not to be affected by the availability of socio-cognitive information, more profound analyses revealed that learners provided with partner information did rely less heavily on initial self-evaluations, but adapted their evaluations and focused more on the partner information provided. Knowledge gain was not affected. In conclusion, social context can be an important factor in self-regulation emphasizing that individual and collaborative research traditions may complement each other.

Introduction

Open learning environments offer the opportunity for students to choose when and what to learn and how to search for what information, in short: to make important study decisions. Consequently, it is no surprise that research on self-regulated learning in online education increased tremendously in the last years (Tsai, Shen, & Fan, 2013). But online learning is not only self-directed, but also social by nature (Shea & Bidjerano, 2010). With a growing body of web-technology and more and more information available online, self-regulated learning is not done in enclosed spaces and, maybe more importantly, not done in isolation. Further, regulated learning is inherently social, because regulating learning means interacting with an environmental and social context (Järvelä & Hadwin, 2013). Learners may encounter differing opinions challenging the learners' knowledge and creating socio-cognitive conflicts, thus initiating further learning processes. Consequently, we can assume that self-regulated learning is severely influenced by its social context. In collaborative research, social context information is seen as a key prerequisite of meaningful social interaction and thus frequently visualized via (cognitive) group awareness tools which explicitly focus on providing socio-cognitive information, i.e. information on other learners' cognitions, to foster individual as well as collaborative learning processes and outcomes (Janssen & Bodemer, 2013). Integrating individual research traditions in a social setting, our study investigates how visualizing socio-cognitive information influences core individual learning processes, especially the search for information, learners' self-evaluation of knowledge, and learning outcomes.

Background

Metacognitive research suggests that self-regulated learners use their monitoring outcomes to guide their study decisions (Nelson & Narens, 1990). One thoroughly researched metacognitive concept is the individual confidence in one's knowledge or answers, which might act as a sensor for the need to re-study material (Thiede, Anderson, & Therriault, 2003) or influence how much time is spent on it (Dunlosky & Ariel, 2011). It can also support learners in prioritizing and sequencing their learning processes, which is especially important with time constraints (Son & Sethi, 2006). While this usually works well for good self-regulated learners, it relies heavily on the individual skills to monitor the learning progress or outcome (Thiede, 1999). Unfortunately, research also suggests that learners are often overconfident with regard to their knowledge (Pressley, Ghatala, Woloshyn, & Pirie, 1990). This might hamper learning progress due to ineffective study decisions, e.g., learners might feel confident about their knowledge and stop studying early even though they would have needed further study trials to reach their goals (Dunlosky & Rawson, 2012).

There are a number of external sources to inform self-evaluation processes. For example, external evaluations of learning operations or products provided by experts may help to adjust learning strategies and / or monitoring judgments (Butler & Winne, 1995). Conversely, metacognitive judgments also influence the way learners perceive and use externally provided information (Kulhavy & Stock, 1989). Confidence has been shown to influence feedback processing, as well as feedback effects (Butterfield & Metcalfe, 2006). One prevalent theory is that unexpected feedback (pointing out errors committed with high confidence) motivates deeper elaboration of the feedback message and thus improves learning outcomes (Fazio & Marsh, 2009).

Another source of information informing the individual self-evaluative system is a community or group. Information from large as well as small learning communities may help learners to re-evaluate or even validate (falsify or verify) their knowledge. In collaborative settings, but also in individual online learning, learners may encounter competing and maybe even conflicting opinions of other learners. Comparing one's own knowledge with other learners' externalized knowledge related information can be a strong asset to learning, thus making comparability a key feature of group awareness tools (Bodemer, 2011). Being confronted with opposing points of view constitutes socio-cognitive conflict (Bell, Grossen, & Perret-Clermont, 1985). Within collaborative learning scenarios, socio-cognitive conflicts have been shown to foster learning processes and outcomes (Bodemer, 2011; Johnson & Johnson, 2009; Mugny & Doise, 1978), at least for epistemic conflicts (Darnon, Doll, & Butera, 2007). They are seen as an important motor for collaborative as well as individual learning (Mugny & Doise, 1978). If confronted with conflicting information about the learning subject, the learners own hypotheses are challenged and they are obliged to explain and maybe even defend or backup their position (Johnson & Johnson, 2009) or integrate the differing views (Darnon et al., 2007). Moreover, conceptual conflict has been shown to foster an active search for information due to an increase in epistemic curiosity (Lowry & Johnson, 1981). Within the context of self-regulated learning, cognitive conflicts suggest re-evaluations of one's own cognitions, e.g., they may introduce uncertainty (Buchs, Butera, Mugny, & Darnon, 2004). As a consequence, learners should be prone to initiate search processes to come to a satisfying solution, e.g., to validate one position (Buchs et al., 2004), but this might depend on the interplay of self- and partner-evaluations (Mugny, Butera, Sanchez-Mazas, & Perez, 1995).

While research done in these areas highly suggests that socio-cognitive information alters individual learning processes (e.g., search processes), existing studies only sparsely integrate individual research traditions on metacognitive self-regulation into a social or even collaborative perspective. Contributing in closing this gap, we investigated if and how individual study decisions during self-regulated learning (especially the search for information) are affected by socio-cognitive information about another learner. Thereby we focussed on the interplay of three potentially relevant variables: the individuals' self-evaluation of knowledge (own confidence), the other learners' self-evaluation (partner confidence) and their conflict status (does the partners' knowledge challenge (conflict) or support (consent) own knowledge). The following research questions were addressed:

1. How does the presence of partner information change the selection of additional information?
2. Does the presence of partner information change cognitive or metacognitive learning outcomes?
3. How do learners take their own confidence, the partners' confidence as well as the partners' answers in comparison to own answers (conflict status) into account when selecting additional information?

Methods

The study took place in early summer (May – June) 2014. Data was assessed in the course of a Bachelor's Thesis (Geerdes, 2014). 63 participants took part in the experiment, from which two had to be excluded due to computer failure, which left us with $N = 61$ participants included in our sample. They were all university students, mainly enrolled in a BA or MA course on Applied Cognitive and Media Science (47 female, 14 male). Their age ranged from 18 to 28 years with a mean age of 21.53 ($SD = 2.09$). All experiments were conducted in our research lab; instructions and materials were given via computer. Learners were randomly assigned to one of two research conditions: with and without socio-cognitive partner information available during learning.

Material and procedure

After welcoming and declaration of consent, the participants received some information about the procedure of the experiment and filled out a demographics questionnaire assessing age, sex, and university course. Then they were all presented with a 970-words text on immunology (adapted from material used in a study of Dehler, Bodemer, Buder, and Hesse, 2011, slightly shortened and re-written) and instructed to read the text carefully for up to 20 minutes. When they had finished, they were asked to answer 20 learning tasks, each consisting of a statement they were asked to judge as being true or false (cf. Figure 1). In addition, they were asked to give a confidence rating for each answer by stating on a binary scale if they were sure or unsure that their answer was correct. The answer was spatially coded (true: top, false: bottom), the confidence was color-coded (high confidence: filled-green, low confidence: hatched white-green) (cf. Figure 1). Afterwards, they were again presented with these 20 tasks as well as their answers and confidence ratings and were given up to 15 minutes to request and study additional information on as many tasks as they wanted to by clicking on a respective button provided for each task. They were also able to change their answers and/or confidence ratings. While learners without partner information (*no partner information* condition) received only their own answers and confidence ratings, learners with partner information (*partner information* condition) additionally received bogus partner information generated by a fixed algorithm, which ensured that partner information was roughly balanced with regard to conflict status and partner confidence for each confidence level (ignoring the validity of the answers). After this second learning phase, participants were all asked to answer the learning tasks again from scratch, including confidence ratings. Finally, they took a knowledge test consisting of 19 questions (four options, single choice format), which assessed the learned concepts more deeply. Again, confidence in each answer was assessed, this time on a six-point Likert scale ranging from "not sure at all" (0) to "absolutely sure" (5).

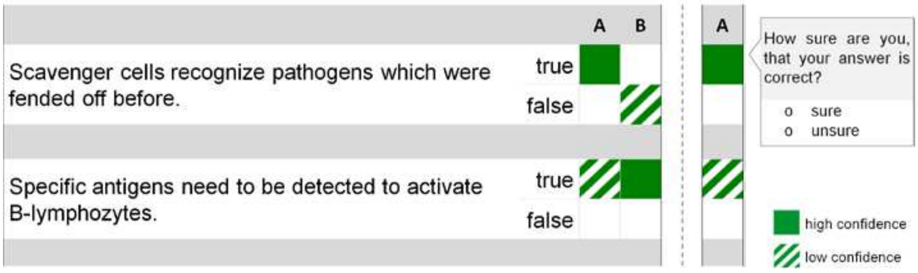

Figure 1. Examples of learning tasks and confidence ratings with (left) and without (right) partner information.

Dependent variables

In order to answer our research questions, we assessed how many and which additional information the learners requested during the second learning phase and in what order and how long they studied the information. To find out if information requests coincided with (low) confidence ratings, we computed within-subject correlations (a method used in metacognition research to describe regulation of study, cf. Thiede, 1999; Thiede et al., 2003). For the *partner information* condition, we also computed a correlation index between conflict status and information requests to capture its influence on learning behaviour. To better understand the interplay between own confidence, partner confidence and conflict status (resulting from a comparison between own and partner answers) on their influence on information requests, we assessed the percentage of information requests for each constellation for the *partner information* condition. Moreover, we assessed performance and confidence levels in the learning tasks and in the knowledge test by counting correctly solved or confident answers and computed a mean confidence for the post test. We assessed relative monitoring accuracy in the form of within-subject phi- or gamma coefficients for each participant (cf. Schraw, Kuch, & Gutierrez, 2013). To analyze the sequence of information requests in conjunction with information on individual confidence (both conditions), partner confidence and conflict status (*partner information* condition only), we ranked the information requests in order of first appearance and computed a mean rank per person for each value (e.g., low) of each variable (e.g., confidence). To eliminate the influence the number of appearances of each value has on its mean rank (mean rank increases automatically with the number of appearances regardless of selection strategy), we computed mean rank differences within each binary variable instead of using the individual values (e.g., [$\text{mean\_rank}_{\text{HighConfidence}} - \text{mean\_rank}_{\text{LowConfidence}}$]). The magnitude of the resulting figure informs about the extent learners give timewise priority to one value before the other, the algebraic sign tells us which one it is.

Findings

How does partner information change the selection of additional information?

To analyse and compare the selection of additional material, we matched the answering patterns of the learners (and their bogus learning partner) with the event of selecting additional information. To compare the selection agendas of the two experimental conditions, we first counted to how many tasks the learners in each group requested additional information and for how long they studied each one (cf. table 1). *t*-tests for independent samples showed no significant differences between the groups for neither the number of information requests ($t(59) = 0.50$, $p = .619$, $d = 0.13$) nor the mean study duration per request ($t(59) = 0.11$, $p = .914$, $d = 0.03$).

In a second step, we analyzed if the availability of partner information changed how learners chose the information to study. Without partner information 79.59% ($SD = 21.05$) of the information requested regarded items answered with low confidence, while with partner information it was only 63.78% ($SD = 23.17$). This difference was statistically significant ($t(59) = 2.78$; $p = .007$, $d = 0.72$). To further evaluate if learners really use their own confidence ratings to choose additional information, but also to see if conflicting opinions might influence these decisions, we computed within-subject correlations between the initial level of individual confidence (high vs. low) or the conflict status (presence or absence of conflict) and the presence or absence of a request for information to each task, resulting in individual within-learner phi-coefficients (cf. table 1). *t*-tests on one sample confirmed a significant positive mean relation index between (lack of) confidence and information requests for the *no partner information* ($t(27) = 9.45$, $p < .001$, $d = 1.77$) as well as the *partner information* condition ($t(29) = 5.55$, $p < .001$, $d = 1.00$) and a positive relation between conflict and information requests in the *partner information* condition ($t(29) = 5.90$, $p < .001$, $d = 1.09$). *t*-tests for independent samples showed that mean phi-coefficients between confidence and information requests differed significantly between the two conditions, with the *no partner information* condition having significantly higher coefficients than the *partner information* condition ($t(56) = 2.67$, $p = .010$, $d = 0.71$), meaning that confidence ratings were more strongly related to information requests if partner information was not available. A *t*-test for dependent samples comparing the phi-coefficient within the *partner information* condition (own confidence vs. conflicts) showed no difference, meaning neither own confidence nor conflict status was more strongly related to information requests than the other ($t(29) = 0.29$, $p = .774$, $d = 0.05$).

Table 1: Descriptive statistics on dependent variables

	partner information								
	available			not available			overall		
	n	*M*	*SD*	*n*	*M*	*SD*	*N*	*M*	*SD*
overall study behavior									
…number of information requests	32	11.81	4.48	29	12.38	4.35	61	12.08	4.39
…study duration per information (in seconds)	32	14.58	8.68	29	14.36	7.32	61	14.48	8.00
regulation of study / within-subject phi-coefficient(*)(**)									
…between information requests and own confidence	30	.35	.35	28	.59	.33	58	.47	.36
…between information requests and conflict status	30	.33	.30	--	--	--	--	--	--
performance / number of correctly solved items									
…in knowledge test	32	5.03	2.07	29	5.07	1.60	61	5.05	1.85
…in learning tasks pre	32	13.13	2.06	29	13.38	2.03	61	13.25	2.03
…in learning tasks post	32	15.13	1.91	29	15.45	1.68	61	15.28	1.80
confidence level									
…in knowledge test (mean confidence level)	32	2.02	0.82	29	2.01	0.85	61	2.02	0.82
…in learning tasks pre (number of certain items)	32	9.91	3.60	29	9.62	3.13	61	9.77	3.36
…in learning tasks post (number of certain items)	32	14.50	3.52	29	15.86	2.80	61	15.15	3.25
monitoring accuracy									
…knowledge test (gamma-coefficients)	32	.21	.45	29	.07	.42	61	.14	.44
…learning tasks pre (phi-coefficients)	32	.20	.22	29	.11	.25	61	.15	.24
…learning tasks post (phi-coefficients)(*)	31	.26	.23	26	.22	.30	57	.24	.26
sequencing of study process / mean rank differences(***)									
…own confidence	32	2.20	3.45	29	3.63	4.02	61	2.88	3.77
…conflict status	32	3.96	3.02	--	--	--	--	--	--
…partner confidence	32	0.03	1.45	--	--	--	--	--	--

(*) due to invariability of one factor, no correlation indices could be computed for some participants
(**) positive values indicate that additional information was requested mainly to uncertain answers / conflicts
(***) positive values indicate that uncertain / partner uncertain / conflicting items were considered first

Does partner information change cognitive and metacognitive learning outcomes?

In order to find out if the presence of partner information influences learning outcomes, we compared how many learning tasks the learners were able to solve correctly pre and post learning and how many items they were able to solve correctly in the knowledge test (cf. table 1). A *t*-Test for independent samples showed no significant group differences in the knowledge test ($t(59) = 0.08$, $p = .937$, $d = 0.02$). Please note that performance in both groups was just beyond chance, indicating high test difficulty. A two-factorial ANOVA with repeated measures on the learners performance in the learning tasks showed a significant main effect of time ($F(1, 59) = 56.32$, $p < .001$, $\eta_p^2 = .49$) with the learners getting better from pre to post, but neither a significant main effect of condition ($F(1, 59) = 0.49$, $p = .488$, $\eta_p^2 = .01$), nor an interaction ($F(1, 59) = 0.02$, $p = .899$, $\eta_p^2 < .001$).

To see if partner information does rattle individual confidence and if being confronted with potentially conflicting information does enhance self-evaluation processes, we compared individual confidence levels as well as monitoring accuracy. We first compared how many learning tasks the learners solved confidently pre and post learning and how mean confidence differed between the groups in the knowledge test (cf. table 1). *t*-tests showed no difference in confidence levels in the knowledge test ($t(59) = 0.06$, $p = .954$, $d = 0.02$). In the learning tasks, there was a significant effect of time with learners becoming more confident from pre to post ($F(1, 59) = 219.06$, $p < .001$, $\eta_p^2 = .79$) and a significant interaction between time and condition ($F(1, 59) = 5.07$, $p = .028$, $\eta_p^2 = .08$) with the confidence levels of learners with partner information not rising as much as without partner information from pre to post. There was no main effect of condition ($F(1, 59) = 0.50$, $p = .482$, $\eta_p^2 = .01$). Subsequently, we compared monitoring accuracy again with regard to the learning tasks pre and post learning (within-subject phi-coefficients between confidence and performance) and the post-test (within-subject gamma-coefficients between confidence and performance). Descriptive statistics are available in table 1. We conducted a Mann-Whitney-Test (due to violations of the normality assumption) to compare the gamma-coefficients between the groups, but found no significant differences ($U = 558.50$, $Z = 1.37$ $p = .172$, $r = .17$). Accuracy on the learning tasks showed a marginally significant effect of time ($F(1, 55) = 3.49$, $p = .067$, $\eta_p^2 = .06$), but neither an effect of condition ($F(1, 55) = 1.73$, $p = .194$, $\eta_p^2 = .03$), nor an interaction ($F(1, 55) = 0.26$, $p = .611$, $\eta_p^2 = .01$). It is worth mentioning that the correlation-coefficients were quite low in general indicating a weak linkage between self-evaluation and performance (low monitoring accuracy).

How do learners consider own and partner information when requesting information?

To investigate how learners take their own confidence, their partner's answer as well as confidence into account when choosing where and when they need additional information, we first focussed on the *partner information* condition and computed which answer patterns led to requests for additional information. Table 2 visualizes each pattern as well as the mean percentage (and standard deviation) of information requests.

Table 2: Mean information request percentage per answer pattern (*partner information* condition, $n = 28^{(*)}$)

conflict				consensus			
self uncertain		self certain		self uncertain		self certain	
partner uncertain	partner certain	partner uncertain	partner certain	partner uncertain	partner certain	partner uncertain	partner certain
$M = 91.96$ $SD = 23.07$	$M = 78.87$ $SD = 36.04$	$M = 51.49$ $SD = 36.43$	$M = 65.77$ $SD = 34.79$	$M = 73.21$ $SD = 36.67$	$M = 65.48$ $SD = 43.49$	$M = 25.00$ $SD = 35.57$	$M = 16.96$ $SD = 33.37$

$^{(*)}$ due to highly unbalanced confidence ratings which did not allow for all constellations, four learners had to be excluded

We computed an ANOVA with our three binary within-subject independent variables describing each pattern (own confidence: high vs. low, partner's confidence: high vs. low, partner's answer: conflicting vs. consenting) and measured the impact on the actual percentage of information requests following each constellation (cf. table 3). Figure 2 illustrates the three-way interaction. Please note that the data was heavily skewed and not normally distributed. We used parametric tests, because methods to model multi-factorial non-parametrical data are scarce. Thus, the results of the inferential analysis should be treated with caution.

Table 3: Results of ANOVA regarding effects of within-subject variables on information request percentage

Effect	Independent Variable(s)	*F*	*df1*	*df2*	*p*	η_p^2
main effect	conflict	22.04	1	27	<.001	.45
	confidence	37.38	1	27	<.001	.58
	partner confidence	1.69	1	27	.205	.06
1st order interaction	conflict * confidence	13.30	1	27	.001	.33
	conflict * partner confidence	2.49	1	27	.126	.08
	confidence * partner confidence	5.01	1	27	.034	.16
2nd order interaction	conflict * confidence * partner confidence	6.09	1	27	.020	.18

As also observed while studying the phi-correlations regarding the first research question, these results strengthen the assumption that confidence as well as conflicts are highly responsible for information requests. Further, the results indicate that they interact in doing so. Looking at the plots in Figure 2, it seems that individual confidence matters more, if there is an agreement between learning partners and less, when there are conflicting opinions involved. In contrast, the statistically significant interaction between own and partner confidence on closer inspection seems to be explained by the second order interaction, thus we abstain from interpreting it, but focus on the second order interaction: in case of consenting opinions, partner confidence does not seem to impact information requests – the only information relevant is individual confidence. In the conflict case this is very different. Here, both confidence variables seem to interact. While conflicts with unsure partner and a sure self triggered the least information request (an unsure partner disagreeing might not be regarded as relevant), a conflict with both partners unsure triggered the most. If the partner is sure of him/herself, the own confidence does not seem to matter too much – information request rate is quite high in both cases.

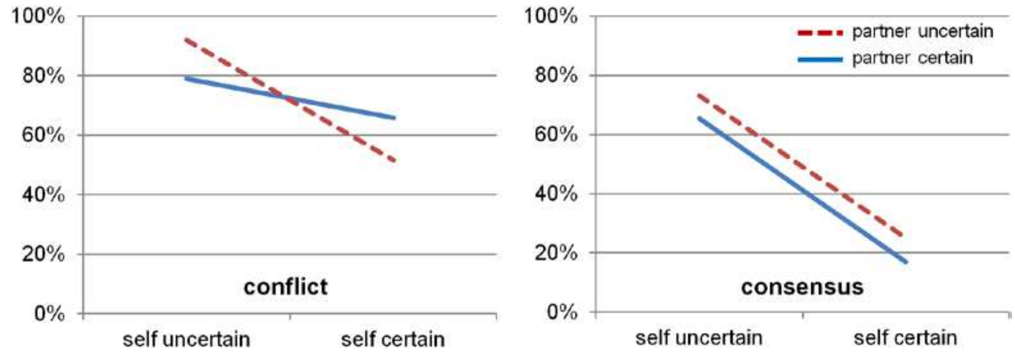

Figure 2. Three-way interaction effect (confidence, conflict status, partner confidence) on information requests.

In a second step we conducted sequential analyses to assess the order of proceeding for the learners in each group. We computed mean rank differences for every variable of interest (procedure described above) to calculate, if learners give precedence to a specific value, e.g., if they consider items with conflicting opinions before considering items with consenting opinions (cf. table 1). *t*-tests on one sample show that own confidence ($t(31) = 3.60$, $p = .001$, $d = 0.64$) as well as conflict status ($t(31) = 7.41$, $p < .001$, $d = 1.31$) influenced the order learners in the *partner information* group requested information –the mean rank differences differed significantly from chance– but partner confidence didn't ($t(31) = 0.10$, $p = .918$, $d = 0.02$). For the *no partner information* group, Wilcoxon signed-rank test (due to violation of the normality assumption) confirmed a similar effect for individual confidence ($Z = 3.67$, $p < .001$, $r = .68$). Taking the direction into account, learners requested information on items they were uncertain about or conflicting items earlier than on items answered with certainty or consenting items. A Mann-Whitney-Test between the conditions showed a marginal effect of condition on the mean rank difference for the (own) confidence dimension ($U = 593.50$, $Z = 1.87$, $p = .061$, $r = .24$), hinting that maybe the *partner information* condition used own confidence slightly less than the *no partner information* condition. Within the *partner information* condition we additionally compared the mean rank differences for the three dimensions own confidence, partner confidence and conflict status with *t*-tests for dependent samples to see which variable showed most influential with regard to order of processing. The results showed that the effect of conflict status was significantly greater than that of own confidence ($t(31) = 2.09$, $p = .045$, $d = 0.34$) or partner confidence ($t(31) = 6.95$, $p < .001$, $d = 1.23$). Mean rank difference for own confidence was significantly greater than for partner confidence ($t(31) = 3.31$, $p = .002$, $d = 0.59$).

Conclusions and implications

Our study aimed at describing how the presence of socio-cognitive information influences individual learning processes – even without the chance to communicate, collaborate or interact with the partner. More precisely, we looked at how partner information (information about knowledge and knowledge evaluations of a potential learning partner) influences the individual search for information and learning outcomes. We expected learners with partner information to access more information and study it longer motivated by the presence of conflicting opinions, but they didn't. Differing opinions might not have the same potentially surprising effect as external feedback, if its origin is unknown (Mugny et al., 1995). Additionally, learning outcomes were not affected by the presence of partner information, but it influenced self-evaluations – although not greatly. As expected, the confidence of learners with partner information available was rattled, presumably by conflicting opinions about the correctness of answers (Buchs et al., 2004), but unfortunately this was independent of performance – if a proper re-evaluation took place, it failed to enhance monitoring accuracy. Even more, this increase in uncertainty did not lead to an increase in study behaviour (e.g., number of information requests or duration of study), but it did change its focus: While in the absence of information on learning partners learners based their study decisions (what to study when) heavily on individual confidence (as frequently reported in self-regulation research, e.g., Thiede, 1999; Thiede et al., 2003), with information on a potential learning partner present, the situation became more complex. Analysing the individual relation between information requests and confidence and conflicts we found that without partner information, own confidence was the main influential factor, with partner information it became less so, with conflicts becoming more important. Timewise, conflicting opinions seemed to capture the learners' attention resulting in slightly higher mean rank differences for the conflict dimension than for the confidence dimension and it also seemed to lessen the effect own confidence had on the search for information as group comparisons indicated (although this difference was not statistically significant). There exist different models on how learners allocate study time and choose and prioritize information to study, mainly resulting from a discrepancy reduction model (Dunlosky & Hertzog, 1998) or a region of proximal learning approach (Metcalfe, 2009), with task constraints (Son & Sethi, 2006) and personal agendas (Ariel, Dunlosky, & Bailey, 2009) being important influential factors. Further studies should conduct more profound analyses in this area to broaden this existing research on individual self-regulation by integrating social scenarios. In our study, learners were reasonably free to select any information and they not only attended to conflicts or uncertainly answered items first, they did so primarily. Three-way interactions confirmed that –as expected from research on socio-cognitive conflicts (Lowry & Johnson, 1981)– conflicting opinions became a major influence on information search, while partner confidence had a somewhat unexpected effect: it was expected that the lower the partner confidence the lesser the experience of conflict and thus the lesser the search for information, but this was not the case. If the learning partner agreed with the individuals' opinion (consensus), information requests were solely based on individual confidence, disregarding partner confidence. If conflicts occurred, partner confidence interacted with own confidence to influence information requests. We can conclude that learners do take into account how the potential partners evaluate themselves, even though they are completely unknown. If they disagree and are sure of themselves, learners re-check their own information. If partners are uncertain about their answers, learners may still question their own answers, but especially and much more so, if they are unsure anyway. The latter case might indicate that maximum uncertainty (both uncertain) with conflicting opinions (no indication that any one answer is correct) changes our evaluation of the task, which might also lead to increased information search (a discrepancy reduction approach might indicate the farthest group distance from getting the correct answer and thus the most reason to attend to the task).

In conclusion, social context does seem to affect individual learning and we should reinforce our (theoretical and empirical) efforts to describe 21th century self-regulated learning as what it is – a communal process. Study decisions are strongly affected by the presence of socio-cognitive information. Focussing on relevant information might be enhanced by the presence of others, but may also become more complicated as more or unknown actors come into play. While this study was able to shed some light on how learners integrate knowledge of other's opinions as well as their self-evaluations to make study decisions in a highly controlled experimental setting, it was beyond the scope to analyse actual collaborative efforts. While we focussed on socio-cognitive information as a source of information to foster individual study decisions, the next logical step would be to explicitly integrate the notion of a learning partner as a source of further information – to interact, to ask, to explain, to question, in short: into an inherently collaborative learning scenario. Even though research on group awareness tools frequently incorporates socio-cognitive information into collaborative learning settings, combining it with metacognitive research by integrating self-evaluations of both partners as well as cognitive information on content-knowledge and incorporating methods of both research traditions may be a strong asset to research on collaborative as well as individual self-regulated learning.

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