When social comparisons are (dys-)functional: The influence of social comparisons, knowledge awareness, and comparison motivation in collaborative learning

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Chapter 1: General Introduction

Collaborative learning has received increasing attention in a variety of settings ranging from primary school to university (Johnson, Johnson, & Smith, 2007; Webb & Mastergeorge, 2003). In collaboration learners have the opportunity to seek others' help as well as provide their own knowledge to their learning partners. Learners can work together on a task and, under the right circumstances, achieve higher knowledge levels and better learning outcomes than individual learners. Collaborative learning not only supports deeper level learning but also the emergence of social relationships and group cohesion (e.g. Garrison, Anderson, & Archer, 2001; Johnson & Johnson, 1999). A vast amount of research clearly supports that collaboration can have an extraordinary potential for learning if implemented in the right way. (Dillenbourg, Baker, Blaye, & O'Malley, 1996).

The nature of collaborative learning is in itself to work *with* another person. Thus, collaborative learners are always confronted with another persons' attitudes, opinions, and capabilities. In other words, collaborative learning carries with it the potential for evaluating one's attributes and abilities in comparison to those of others', thus, the potential for social comparisons between learners (Festinger, 1954). Therefore, it comes to no surprise that social comparisons are strongly facilitated when learning with others (Dijkstra, Kuyper, van der Werf, Buunk, & van der Zee, 2008). Hence, at the same time that collaboration can support learners' engagement in class, the learning partner also introduces a standard that can be used for social comparisons.

Nevertheless, certain collaboration settings might facilitate those comparisons more than others. Structured collaboration is often used to heighten the efficiency of collaborative learning settings (Dillenbourg et al., 1996). To meet structural needs, researchers in computer-supported collaborative learning (CSCL) developed knowledge awareness tools (e.g. Engelmann, Dehler, Bodemer, & Buder, 2009). However, providing learners with awareness of their learning partners' knowledge might introduce the aforementioned comparisons more strongly than traditional collaboration. The consequences of social comparisons in CSCL settings with knowledge awareness are unclear and understudied.

How will these comparisons influence a learner's behavior and engagement in likewise learning settings? Social comparisons are part of our everyday life and can shape how and why we interact with others. There is indeed research examining *how* social comparisons influence learners in collaboration. So far, researchers mainly focused on who learners compare with, which comparison direction they prefer, as well as what affective,

cognitive, and behavioral consequences social comparisons have for learners in collaboration (for an overview see: Dijkstra et al., 2008). However, missing in current research is how *structured* collaboration as in CSCL influences learners' social comparisons and consequently their engagement and learning during their collaboration with others.

Furthermore: what happens before collaboration starts? Do social comparisons already effect who learners choose to study with before collaboration? For the duration of collaboration in CSCL learners' comparison options are often constrained. Learners can only compare themselves to their current collaboration partner or avoid comparison altogether. However, before collaboration, comparison options could be unconstrained, thus, learners might be free to seek learning partners according to their individual needs and motivations. Generally, having a choice in their learning partner provides learners with a sense of control over their situation as well as motivates students to engage in learning (Pintrich, 2003). Therefore, giving learners a choice might be beneficial for collaborative learning. But is it indeed?

The current dissertation addresses the evoked questions by examining the influence of social comparisons in CSCL settings that provide knowledge awareness as well as investigating if learning partner choices are influenced likewise. In doing so, this dissertation combines social psychological and educational research. The present chapter includes four parts: The first part, named *Collaborative learning – benefits and pitfalls*, presents an introduction to collaborative learning with its advantages and disadvantages and how it can be supported. The second part of this chapter, named *Social comparison theory – A summary of research*, presents an introduction to social comparison theory including a definition of social comparison and a review on comparison levels, motives and targets. The third part, titled *Social comparison in collaborative learning: Research so far* outlines the deficits I wish to address with this dissertation. Finally, the last part of this chapter introduces *The current dissertation*, presenting the research questions of this dissertation and an overview of the following chapters.

Collaborative learning – benefits and pitfalls

Collaborative learning builds on the idea that learners elaborate their knowledge together in groups in order to reach higher knowledge levels and get support from co-learners (Cohen, 1994). Whereas cooperation is characterized by task-division between learners, collaboration is defined by learners working together on a shared task without direct and immediate supervision of a teacher (e.g. Cohen, 1994; Dillenbourg et al., 1996). In collaboration, learners are potentially confronted with their learning partners' different perspectives and knowledge levels. By dissolving such socio-cognitive conflicts through discussion, learners can achieve higher performance and knowledge levels compared to learners working individually (Fischer, Bruhn, Gräsel, & Mandl, 2002; Slavin, 1996; Stahl, 2004).

Furthermore, successful knowledge exchange benefits both more and less knowledgeable learners. If the learners' knowledge levels are somewhat different, a necessity for collaboration to be effective (Dillenbourg et al., 1996), the less knowledgeable learner receives knowledge input from the superior other whereas the more knowledgeable learner can improve their own knowledge by explaining learning content to another and thereby reflecting their own opinion and knowledge (Webb, 1991). By doing so, collaboration can enhance critical thinking among learners (Gokhale, 1995).

However, "…collaboration is in itself neither efficient or [sic!] inefficient." (Dillenbourg et al., 1996, p.8). Thus, collaboration between learners does not necessarily reach its full potential (e.g. Cohen, 1994; Fischer & Mandl, 2005; Kollar, Fischer, & Hesse, 2006; Weinberger, Reiserer, Ertl, Fischer, & Mandl, 2005). For collaboration to be efficient certain prerequisites need to be given. First, learners need to be able to refer to another person's knowledge, thus, decenter from their own perspective. Indeed, a key element of any communication is the ability to take the perspective of the communication partner (Fussell & Krauss, 1992). Learners need to build a common ground about their partners' knowledge in order to communicate and thus learn effectively. Unfortunately, learners often lack this ability and fail to match their explanations to their learning partner's current knowledge and capabilities (Wittwer & Renkl, 2008), often referred to as the "curse of knowledge" (Birch & Bloom, 2007; Camerer, Loewenstein, & Weber, 1989; Nickerson, 1999).

Fortunately, collaboration can be supported in numerous ways, for example by structuring learners' interaction or providing learners with information about their learning partner's knowledge level. In order for groups to interact efficiently a certain amount of structure might be required. Therefore, group discussions and learning are often structured by

collaboration scripts, learning protocols, or reciprocal learning (Kollar et al., 2006; Palinscar & Brown, 1984; Pfister & Mühlpfordt, 2002). Collaboration scripts support the reduction of inert knowledge, facilitate the collaborators understanding, for example of the learning material, and reduce process losses (e.g. Renkl, Mandl, & Gruber, 1996; Weinberger, Stegmann, & Fischer, 2010) by incorporating learning objectives, specific types of activities, sequencing, various types of representation, as well as role distributions (Kollar et al., 2006).

Furthermore, effective collaboration can be supported in computer-supported collaborative learning (CSCL) environments. Computer-supported learning enables spatially distributed learners to work together collaboratively without having to meet face-to-face, giving them more flexibility and easier access to others' knowledge (Dehler, 2009). Research on CSCL has received an increasing amount of attention, demonstrating potential benefits for learners. CSCL allows for learner contributions to be more equal and the dominance of one person to be less strong compared to face-to-face learning (Kiesler, Siegel, & McGuire, 1984). Additionally, CSCL seems to increase students' motivation (Fjermestad, 2004).

However, researchers also noted several problems with computer-supported collaborative learning. Besides missing or reduced context cues and the absence of regulating feedback (Kiesler et al., 1984), Janssen and colleagues (2007) observed interaction problems regarding coordination and communication (Janssen, Erkens, Kanselaar, & Jaspers, 2007; Kreijns, Kirschner, & Jochems, 2003). Therefore, recently researchers tried to provide conditions that are comparable to face-to-face communication. (Bodemer & Dehler, 2011). For example, interpersonal barriers can be reduced if interpersonal cues about social, behavioral, and cognitive states of communication partners are provided (Buder, 2007). Furthermore, in order to address the difficulties of learners to adapt their knowledge exchange to the knowledge level of a collaboration partner, researchers have started to make learners aware of their collaboration partner's knowledge.

Supporting CSCL with knowledge awareness tools

Being informed and having received information about another's knowledge is generally referred to as *knowledge awareness* (Engelmann et al., 2009). Therewith, learners can estimate their learning partner's areas of expertise and knowledge deficits. With knowledge awareness more knowledgeable learners are enabled to provide their learning partner with explanations that directly suit their learning needs. On the other hand, with knowledge awareness less knowledgeable learners benefit, because they can directly ask for information that their partner can actually provide. This way process losses due to ineffective

communication between learners can be minimized (e.g. Dehler, Bodemer, Buder, & Hesse, 2011; Nückles, Wittwer, & Renkl, 2005, Wittwer, Nückles, Landmann, & Renkl, 2010).

Of course, learners can also form knowledge awareness in the absence of explicit cues. The learning partner can either provide information about their own knowledge level or the learner can extract knowledge-related context information about the learning partner by analyzing their earlier statements while collaborating. If given, this enables the learner to adapt their contributions to their learning partners' needs. While this extraction of information in unsupported learning environments is rather incidental and unsystematic, knowledge awareness tools achieve this informed stage systematically. With knowledge awareness tools information about the learning partners' knowledge can be visualized and easily extracted by a learner (Engelmann et al., 2009).

Learning partners in collaborative learning

Besides meeting structural needs in collaborative learning, who people learn with is, of course, an additional important factor for the effectiveness of collaborative learning. Often, especially in CSCL, collaboration partners are set. However, if collaboration partners are not assigned by the teacher, learners are free to choose a learning partner among their classmates. Unfortunately, research on learning partner choices is scarce. Who students like to study is at least influenced by their mood (Forgas, 1991) or the popularity of their collaborative partner (Gommans, Segers, Burk, & Scholte, 2015). Interestingly, Gommans et al. (2015) showed that choosing a popular student as a collaboration partner can positively influence knowledge gain of a less popular student. One would also expect learners to prefer to learn with someone they like and share interests with.

While deciding who to learn with, a learner's motivation to do well surely will affect the choice of a learning partner differently than the motivation to connect with others socially. In an attempt to clarify the role of motivation French (1956) investigated how achievement motivation compared to affiliation motivation influenced working-partner choices in students. In French's work students had to decide between a competent non-friend and a less competent friend to work with on a task. Results showed that students with high achievement motivation rather chose more competent non-friends to work with than less competent friends. This indicates when being motivated to do well the social closeness to a learning partner becomes less important. Students rather choose the learning partner that provides the most potential to get better at a task, thus the best performing partner option that is available to them.

In conclusion, collaborative learning surpasses individual learning if the right conditions are met. Its effectiveness can be supported with structural conditions that facilitate students' engagement and simplify learners' assessment of their learning partners' knowledge. Also, a learning partner that fits learners' current motivation and needs can have positive effects on learners' performance. However, if learners work together on a task, they can easily become aware of their learning partners' abilities and skills. Thus, collaborative learning settings strongly encourage social comparisons among learners. Therefore, in the next chapter, social comparison theory will be introduced and an overview of research on social comparisons will be provided.

Social comparison theory – A summary of research

By interacting with other students in collaborative learning, students can easily become aware of differences in their abilities and skills. There might be someone who is faster in running, quicker in solving a math test, or slower in finishing an essay. Therefore, not comparing their own performance to a classmate's seems almost impossible in educational environments. The desire to learn about the self by comparing our accomplishments, attributes, and opinions with those of others is not restricted to collaborative learning settings but quite universal. The idea of social comparisons was first stated by Festinger (1954). He describes social comparison as to originate from "a drive to evaluate his opinions and abilities" (Festinger, 1954, p.117). Generally, social comparisons are perceived as providing the most useful information about the self and one's standing in relation to others'. Of course, people can also compare their current performance with their past or future accomplishments, namely temporal-self comparison (Wilson & Ross, 2000). For example, if a student learns through comparison with his or her last year's math grade and finds that he or she now achieved a better grade, past self comparison would bolster his or her self-esteem. Also by comparing one's performance with possible future higher performances, learners can motivate themselves to show more engagement in learning. However, if they are motivated to evaluate themselves accurately, people prefer social comparison over temporal-self comparisons (Wilson & Ross, 2000).

People's use of comparisons in self-evaluation is extensive when objective information about the self is unavailable (Festinger, 1954). Whether it is about physical appearance, conflicting opinions, or performance, everyday interactions provide us with opportunities to compare our abilities, accomplishments, and lifestyles with others (e.g. Wheeler & Miyake, 1992). Even though, learners are constantly confronted with social

comparison information while learning in school, not all of it will be used for self-evaluation. Whether a learner uses a particular comparison is heavily influenced by situational circumstances as well as individual differences. In order to gain information for self-evaluation, it is important how similar the comparison target and the learner are. For example, available comparisons are more likely to be used for self-evaluation in the case of comparable demographics, such as same sex as the target individual or similar levels of education (Festinger, 1954; Suls, Gaes, & Gastorf, 1979; Zanna, Goethals, & Hill, 1975). Furthermore, people restrict social comparisons to others whom they consider sources of diagnostic information (Gilbert, Giesler, & Morris, 1995; Pemberton & Sedikides, 2001). The classroom provides these specific conditions and thus strongly facilitates the occurrence of social comparison behavior.

However, not every student will be interested in social comparison information. There are stable individual differences in the tendency to use information about others for self-evaluation. Whereas earlier researchers suggested that virtually everybody engages in social comparisons from time to time (e.g. Festinger, 1954), Gibbons and Buunk (1999) found that some people are more predisposed than others to rely on social comparisons. The authors developed and tested a scale to assess people's social comparison predisposition – namely social comparison orientation (Gibbons & Buunk, 1999). The impact of such individual differences is well documented in a variety of domains, such as satisfaction with social life, burnout among nurses and relationship satisfaction (Buunk, Groothof, & Siero, 2007; Buunk, Zurriaga, & Peíro, 2010; Dijkstra, Buunk, Tóth, & Jager, 2007). Thus, people who are predisposed to rely on social comparisons are more likely to be interested in comparative information and use this information while interacting with others, for example in collaborative learning. Therefore, depending on their tendency to use others for comparison, students are affected differently when they learn about another student's performance.

Motives for social comparison - Why do learners compare?

Since its' first statement, Festinger's social comparison theory has been researched and revised extensively. Festinger (1954) postulated that people seek informative feedback about abilities in order to satisfy their need to maintain a stable and accurate self-view (Corcoran, Crusius, & Mussweiler, 2011; Festinger, 1954). He proposed that people use social comparison merely for self-evaluation whereas more recent research also suggests other motives to drive social comparisons, namely self-improvement and self-enhancement (e.g. Buunk, Cohen-Schotanus, & van Nek, 2007; Wayment & Taylor, 1995; Wood, 1989).

Of course, the result of self-evaluations can reflect unfavorably on one's attributes, conflicting with a desire to feel good about one's attributes and accomplishments. This motive for social comparison is generally referred to as self-enhancement (e.g. Buunk et al., 2007). Especially, when facing threat, people tend to compare with others who are worse off than themselves in order to enhance their self-esteem. People sometimes even create favorable comparisons where none previously exist (Tesser & Smith, 1980). In an experimental study participants were asked to supply obviously helpful or unhelpful clues to either a friend or a stranger during a knowledge test. The authors found that if the task was relevant for participants' self-definition, they gave harder clues especially to their friends than to strangers. Thus, friends actively undermined another friend's performance in order to generate a favorable social comparison (Tesser & Smith, 1980).

However, in learning contexts, self-improvement motives seem to dominate self-enhancement motives. Thus, social comparison is often engaged in in order to gain useful information on how to improve one's current performance by using others as a model or for inspiration (Buunk et al., 2007; Lockwood & Kunda, 1997). Indeed, Festinger (1954) himself implied that people tend to use better performing others for social comparison due to their desire to improve. However, self-improvement is not only gained from comparisons with better performing others. Learners can also learn what not to do if they compare themselves with others who perform worse (Helgeson & Mickelson, 1995; Wood, 1989).

So far, researchers conducted investigations on motives for social comparison (self-evaluation, self-enhancement, and self-improvement) independently from the predisposition to use information about others for social comparisons as assessed by social comparison orientation. Thus, a link between these diverse social comparison motives is missing.

Comparison direction – Who do learners compare with?

It is in the nature of collaborating with others, and thus also in the conditions of CSCL, to provide a vast amount of comparison targets and choices. Depending on diverse preconditions, like learners' well-being or their motivation, learners can choose comparing themselves with worse, better, or equally performing collaboration partners. The reasons for choosing a certain comparison level are numerous. A vast amount of research has substantiated that the choice of a social comparison target is also influenced by people's social comparison motives. Thus, whether individuals seek self-evaluation, self-improvement, or self-enhancement partly predicts their preferred direction of comparison (Dijkstra et al., 2008). Choosing an upward comparison, thus comparing oneself to the performance or ability

of a higher achieving other, can, first of all, provide crucial information on how to improve (e.g. Ybema & Buunk, 1993; Taylor & Lobel, 1989). Indeed, in most learning settings students tend to compare themselves with better performing others with the motive to improve their own performance. They use these upward comparisons in order to gain knowledge and information on how to master a task (e.g. Blanton, Buunk, Gibbons, & Kuyper, 1999; Dijkstra et al., 2008).

Furthermore, upward comparisons may be motivating to improve or set higher personal standards if learners identify with successful comparison targets, leading to imitation of the comparison target' actions and consequently to better performance. Viewing others succeed can lead learners to set higher personal goals as well as endow them with a sense of their own potential (Buunk, Collins, Taylor, VanYperen, & Dakof, 1990; Lockwood & Kunda, 1997). Interestingly, people often choose to compare upward after experiencing failure in order to get hope and inspiration (Ybema & Buunk, 1993).

If learners are motivated to evaluate their own performance they tend to compare themselves with similar others who perform slightly better (e.g. Blanton et al., 1999; Huguet, Dumas, Monteil, & Genestoux, 2001). These comparison targets provide an estimate of one's own standing without presenting a self-threatening comparison. However, being inferior to someone else can be hurtful. Upward comparisons can be discouraging if the comparison targets' performance seems unattainable (Lockwood & Kunda, 1997). In a series of studies Lockwood and Kunda (1997) investigated under what circumstances better performing others are seen as inspiration and role models for further improvement. Participants felt inspired only if the domain of excellence was self-relevant and the other's performance seemed attainable in the future. Thus, learners can decide to voluntarily reduce the discrepancy between their own and their comparison target's performance level. If, however, another's performance does not seem attainable, people get discouraged and tend to decrease the discrepancy artificially, for example by undermining another's performance as observed by Tesser and Smith (1980) or even disengage physically or psychologically from the task (e.g. Muller & Fayant, 2010; Schunk, 1987).

Sometimes people even choose upward comparisons in order to achieve self-enhancement through self-improvement (Collins, 1996). Under conditions of threat to one's self-esteem and stress, people usually tend to compare themselves to worse performing others (Wills, 1981). Through such comparison, thus downward comparison, people can boost their self-esteem and further reduce anxiety (e.g. Buunk et al., 1990; Taylor & Lobel, 1989). Generally, the motive to self-enhance through social comparisons is intertwined with a

preference for downward comparison, thus comparing oneself to someone who is worse off in performance, a relevant ability, or even health issues in order to feel better. However, if a downward comparison leads to positive affect depends on a person's pre-comparison well-being, for example feeling discouraged or feeling (un-)happy, and their perceived control (e.g. Lyubomirsky & Ross, 1997). In a study with cancer patients, Buunk and colleagues (1990) investigated the consequences of social comparisons on participants' affect. They found that if patients were low in self-esteem and felt little control over the progress of their illness, comparing themselves to another patient who was doing worse made them more anxious and stressed (see also Suls & Wheeler, 2012; Wood, 1989; Wood, Taylor, & Lichtman, 1985). However, hardly any studies conducted among students revealed a preference for downward comparisons in collaborative learning (Dijkstra et al., 2008).

Furthermore, one's preferred comparison direction can vary with the relationship people have with the comparison target (Wheeler & Miyake, 1992; for an overview see Wheeler, 2000). Comparisons of similar performance levels are more likely between friends, whereas comparisons of dissimilar performance levels are more frequent in more distant relationships. The reasons being that, as argued by Tesser (1988), upward comparison with friends on self-relevant dimensions is particularly threatening. Thus, it might be particularly stressful for learners to work collaboratively with their classmates that are also close friends.

In conclusion, social comparisons strongly influence everyday life and whom students like to compare and work with. It is thus reasonable to expect social comparisons to also appear in and influence learning during collaboration. The role of such comparisons in collaborative learning has been previously investigated to some amount. Therefore, I will address previous observations next.

Social comparison in collaborative learning: Research so far

There is research demonstrating the influence of social comparisons in collaborative learning. For example, Huguet and colleagues (2001) investigated students' social comparison choices in the classroom and how these choices affected their performance. They found that social comparison information affected several dimensions of task performance, such as attention to and time spent on the task as well as students' persistence and final performance level (Huguet et al., 2001). Also, upward comparisons can be motivating to improve (Dijkstra et al., 2008; Lockwood & Kunda, 1997; Ybema & Buunk, 1993). Ybema and Buunk (1993) investigated how previous failure and perceived control effect information seeking by

learners. The authors manipulated participants' failure with a bogus feedback as well as potential control over a personality trait and observed from whom they would like to get information from and with whom they would like to work with on a subsequent task. Ybema and Buunk (1993) found that learners who felt in control over their future performance chose to seek information from better performing others in order to improve their own performance. Furthermore, the preference for learning with another was also more strongly upward when participants experienced previous failure than when they experienced previous success. Thus, social comparisons seem to support learners' performance in numerous ways.

However, several studies also demonstrated that social comparisons can indeed be harmful to learners' achievement. Johnson and colleagues (2007) state that social comparison does occur in collaboration and can influence learning for the worse (Johnson et al., 2007). As mentioned above, learners sometimes create favorable comparisons by supplying unhelpful clues to friends (Tesser & Smith, 1980). Furthermore, in a series of studies Buchs and colleagues (2004, 2010) demonstrated how evaluative pressure occurring through social comparisons can become a distraction and influence learning for the worse, whereas taking steps to reduce evaluative pressure improved learning (Buchs, Butera, & Mugny, 2004; Buchs, Pulfrey, Gabarrot, & Butera, 2010).

In conclusion, some research has been conducted in order to clarify the influence of social comparisons in collaborative learning. Yet, there are areas that are beyond researchers past attention. As mentioned above, in order to more effectively manage the difficulties in collaborative learning, especially in CSCL, knowledge awareness has been introduced. As stated, knowledge awareness supports knowledge exchange and facilitates better learning outcomes as well as has the potential to surpass face-to-face collaborative learning (Buder, 2007; Dehler et al., 2011). However, it is unclear how the information about a learning partner's knowledge level will influence learners who tend to use information about others for social comparison. I suggest that knowledge awareness introduces new problems into collaborative learning that need to be addressed empirically. If knowledge awareness does indeed facilitate social comparisons in collaborative learning, it also facilitates all advantages and disadvantages social comparison can have for learners. Social comparisons have diverse outcomes for learners depending whether learners are confronted with an upward or a downward comparison target.

Therefore, the current research first applies social comparison theory to collaborative learning settings that use knowledge awareness for structuring learner interactions. In these settings learners comparison options are mostly constrained to the learning partner assigned.

If knowledge awareness provides a learner with information about a more knowledgeable other, it can lead them to engage and put more effort in the task, thus, motivating the learner to improve their own performance in order to minimize the gap between themselves and their collaboration partner (e.g. Muller & Fayant, 2010). If, however, knowledge awareness introduces a learner to information about someone who has less knowledge, self-evaluation maintenance intentions might be provoked, leading to detrimental self-evaluation defense (Tesser, 1988).

Furthermore, previous research investigated whom learners compare themselves with in collaborative learning. Researchers agree that learners tend to compare their own performance and abilities with others who perform slightly better on self-relevant tasks. Thus, learners prefer to compare upward in order to improve themselves (e.g. Dijkstra et al., 2008). However, research failed to address the influence of a learners' tendency to use the information about another's achievement for social comparison on learning partner choices. Thus, who do students' choose to learn with if their choice is unconstrained? In other words: do social comparisons also influence learners before collaboration, when they chose their learning partner? Also, it is up for further investigation how the tendency to use information about others for social comparisons influences learning partner choices when social comparison motives are simultaneously active.

The current dissertation

The current dissertation investigates how social comparisons influence learners' actions in (computer-supported) collaborative learning. As previously outlined, it is unclear how providing learners with knowledge awareness effects learners' comparison behaviors. Here, for the duration of collaboration, learners' comparison options are often constrained. Learners can either accept comparison with their partner or avoid comparison altogether. How this constrained comparison introduced by knowledge awareness in CSCL environments effect learners' engagement and performance is, in conclusion, my first research question:

> **RQ1**: How do social comparisons facilitated by knowledge awareness influence learners' engagement and learning?

Consequently, the question arises if social comparisons also influence learners before actual collaboration; that is when they are free to choose their collaborative learning partner. Research has not been investigating yet, who people choose to learn with when faced with unconstrained comparison options and how this choice is affected by competing social

comparison tendencies and motives. I will address this research gap with my second research question wherein I am concentrating on unconstrained comparison choices in collaborative learning. In other words:

> **RQ2**: How do social comparisons tendencies influence learning partner choices and consequently learners' social comparison motives?

RQ1 is addressed in the following two chapters. *Chapter 2* focuses on the influence of social comparisons and knowledge awareness on more knowledgeable learners, thus, downward comparisons in collaborative learning. In Chapter 2 I test the hypothesis that the tendency to compare facilitated by knowledge awareness leads to withholding of information by more knowledgeable learners. Furthermore, I expect knowledge awareness to lead to better matching of a learner's explanation to their learning partner's needs. Two studies test this proposition with dispositional as well as situational induced social comparisons, manipulating knowledge awareness, and observing their effects on learner's knowledge exchange and explanation matching in a collaborative learning setting. This chapter demonstrates that at the same time that knowledge awareness effectively coordinates knowledge exchange between learners, it can also lead to knowledge hoarding by more knowledgeable learners who tend to use social comparisons for self-evaluation.

In *Chapter 3*, I focus on the influence of social comparison and knowledge awareness on less knowledgeable learners, thus, upward comparisons in collaborative learning. I hypothesize that knowledge awareness leads to more engagement by less knowledgeable learners, if they tend to use others for social comparison. Also, I expect learners to better match their request for explanation to their learning partner's expertise. In two studies I provide learners with help from a more knowledgeable partner in understanding a biology lesson, I manipulate participants' awareness of their partner's superior knowledge, and I measure participants' predisposition to rely on social comparison for self-evaluation. Finally, I measure participants' task engagement and their learning outcome. In Study 1 I additionally investigate a potential moderator of learners' use of knowledge awareness for social comparison, namely comparison diagnosticity. This chapter demonstrates that social comparisons facilitated by knowledge awareness can lead to more engagement as well as higher learning outcomes for less knowledgeable learners.

Furthermore, *Chapter 4* addresses RQ2 and concentrates on unconstrained learning partner choices in collaborative learning. More precisely, I investigate the influence of habitual and strategic social comparison motives on choosing a learning partner. I propose

that a predisposition to habitual social comparisons renders learners insensitive to the beneficial influence of strategic social comparison motives when choosing who to learn with. In two studies I assess learners' habitual and strategic comparison motives as well as their influence on learning partner choice for an upcoming learning task. In this chapter I show that habitual comparisons can prevent strategic comparison motives to work effectively and lead learners to not choose the learning partner that would provide the most learning potential.

Finally, *Chapter 5* includes the *General Discussion* of the empirical findings presented in Chapters 2, 3, and 4. Here, the empirical findings reported in the previous chapters will be summarized and their strengths and limitations discussed. Furthermore, I present their implication for research on social comparisons and collaborative learning as well as ideas for future research. This chapter closes with practical implications and a conclusion.

Please note, that the empirical Chapters 2, 3, and 4 are structured in a way that allows for them to be read separately and are partially published in scientific journals. Therefore, there is structural and theoretical overlap between the chapters to some extent. Furthermore, in the empirical chapters I use 'we' instead of 'I' with regard to the authors, since the research was conducted and written in collaboration.

Chapter 2: Motivated shortcomings in explanation: The influence of downward social comparisons and knowledge awareness on explanation[1]

Effective explanation is critical to human learning and development. In formal education, people receive explanations from teachers, tutors, and peers. As children grow up, they receive explanations from parents (how to ride a bike) as well as from friends (how to lie without getting caught). In adulthood, training in a new job or for new responsibilities in a current job often involves explanation from a more experienced colleague. Not surprisingly then, explanation occupies an important place in many disciplines, including both educational science and social psychology.

The efficacy of explanation has been most studied in educational contexts like collaborative and dyadic learning. When a good explanation occurs, it benefits both the person receiving the explanation and the person providing the explanation. The person receiving an explanation gains assistance with material that is inaccessible without help from someone more capable (P. A. Cohen, Kulik, & Kulik, 1982; Vygotsky, 1978). The person providing the explanation processes the concerned material in new ways, allowing the explainer to detect errors or deficiencies in his or her own understanding and to restructure his or her own knowledge as a result (Webb, 1989, 1991; Webb & Mastergeorge, 2003; Webb, Troper, & Fall, 1995).

However, explanations do not always convey information effectively. Most important for this work, explanations often fail to match a recipient's current knowledge and capabilities (Wittwer & Renkl, 2008). Neither an explanation about something a recipient already understands nor an explanation that is too advanced for a recipient to comprehend would be useful to a recipient.

This necessity to match an explanation to recipient knowledge and capabilities presents a problem for effective explanation because people generally find it difficult to discount their own privileged knowledge when estimating other people's perceptions or comprehension (the so-called "curse of knowledge"; Birch & Bloom, 2007; Camerer et al., 1989; see Koriat & Bjork, 2005, for an intraindividual treatment). In the context of explanation, this curse means that explainers often infer knowledge and understanding in

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[1] This chapter has been published in the following article:
Ray, D. G., Neugebauer, J., Sassenberg, K., Buder, J., & Hesse, F. W. (2013). Motivated shortcomings in explanation: The role of comparative self-evaluation and awareness of explanation recipient's knowledge. *Journal of Experimental Psychology: General*, *142*(2), 445-457. doi:10.1037/a0029339

another person from their own knowledge and understanding (Keil, 2006; Nickerson, 1999), even when explainers are teaching professionals (Chi, Siler, & Jeong, 2004; Nathan & Koedinger, 2000; Nathan & Petrosino, 2003). In cases where background knowledge differs between someone providing and someone receiving an explanation, the explainer might then draw on concepts or competencies that the explanation recipient lacks and thus fail partially or completely.

Clearly, one way to overcome these difficulties is to make explainers aware of what the person receiving their explanation already understands (which we term *knowledge awareness*). Supporting this assertion, investigations into whether explanations can be improved by facilitating explainers' knowledge awareness have been promising. Providing information about recipient knowledge to explainers allows more effective explanation matching both in peer learning dyads and between tutors and tutees (Dehler et al., 2011; Engelmann et al., 2009; Nückles et al., 2005; Wittwer et al., 2010).

Although the existing body of work clearly supports the importance of explainers being aware of explanation recipient knowledge, we suggest that knowledge awareness also introduces new important and unconsidered problems into effective explanation. We suggest that awareness of relative knowledge, by definition, carries with it the potential for self-evaluative comparison of knowledge between an explainer and an explanation recipient. Once someone providing an explanation is aware of what the person receiving an explanation understands, that explainer can use the recipient's knowledge as a comparison standard to evaluate his or her own abilities. In other words, knowledge awareness introduces the potential for social comparison, the evaluation of one's attributes and abilities relative to those of another person rather than by some objective metric (Festinger, 1954), in explanation.

This potential for social comparison, in turn, might undermine information sharing through explanation. When explainers are motivated to draw on the social comparison presented by knowledge awareness for self-evaluation, we suggest that sharing information in an explanation and matching that explanation to a less capable recipient's needs are antagonistic. We suggest that the very process of matching an explanation to recipient learning needs might undermine explainers' motivation to provide substantive content in an explanation when an explainer draws on social comparison for positive self-evaluation. Because knowledge awareness plays a central role in both theoretical accounts of effective explanation (e.g., Keil, 2006; Nickerson, 1999; Wittwer & Renkl, 2008) and in practical interventions designed to facilitate effective explanation (e.g., Dehler et al., 2011; Engelmann et al., 2009; Nückles et al., 2005; Wittwer et al., 2010), understanding this potentially

damaging influence of social comparison is vital to a comprehensive understanding of effective explanation as well as to efforts to support effective explanation across learning contexts.

Social comparison, knowledge awareness, and explanation

Daily life presents many potential social comparison standards but not all of them are used for self-evaluation. An available comparison is most likely to be used for self-evaluation when a target of comparison is relatively similar to the comparer. For example, shared demographics and comparable levels of training both encourage the use of an available comparison standard for self-evaluation (Suls et al., 1979; Wheeler, Koestner, & Driver, 1982). In the context of explanation and knowledge awareness, this means that the social comparison presented by knowledge awareness is most relevant to explanations between people in similar roles, for example, during collaborative learning among students in the same class or during training between colleagues who share or will share an occupational role.

It is important to note that both chronic individual differences and situational factors affect the likelihood of drawing on a particular comparison for self-evaluation. Individual predispositions to rely on social comparison for self-evaluation derive from multiple sources, such as mastery and performance orientations as well as specific combinations of these two orientations (Darnon, Dompnier, Gilliéron, & Butera, 2010; Régner, Escribe, & Dupeyrat, 2007). The importance of such individual differences is well established in a variety of domains, including burnout among nurses, adjustment to chronic illness, and relationship satisfaction (Buunk, 2006; Buunk et al., 2010; Dijkstra et al., 2007; Gibbons & Buunk, 1999).

Theories of situationally motivated social comparison originally focused on the desire for accurate self-evaluation but evolved to emphasize the desire for positive self-evaluation through either self-improvement (changing one's attributes for the better) or self-enhancement (making existing attributes appear more positive; Wood, 1989). When seeking self-improvement, people tend to engage in upward comparison, that is, comparison between the self and a better performing other (Butler, 1992). Comparison with a better performing other supports self-improvement by providing information about the means by which one can improve and can increase standards for one's own performance (Bandura, 1978; Blanton et al., 1999). When seeking selfenhancement, people tend to avoid upward comparison and to instead engage in downward comparison, that is, comparison between the self and a worse performing other (Wills, 1981). Comparison with a worse performing other provides a contrast that reflects well on one's current attributes and abilities (Wood et al., 1985).

It is important to note that self-enhancement can also motivate people to create favorable social comparisons where none previously existed. Perhaps the most famous example of creating favorable social comparisons comes from a laboratory experiment (Tesser & Smith, 1980) in which participants were asked to supply clues to another participant during a knowledge test. The participants supplying the clues were given the option to supply obviously helpful clues or obviously unhelpful clues. When a good performance by the second participant would have presented a threatening social comparison to the participants supplying the clues, these participants chose unhelpful clues and thus undermined the other participant's performance. In other words, people generated a favorable social comparison by actively undermining another person's performance. This finding is all the more surprising because this subtle sabotage occurred between friends who had been recruited for the study together and who knew and liked one another outside of the laboratory.

In most learning contexts, self-improvement motives appear to dominate self-enhancement motives. Students most commonly choose to draw social comparisons with better performing classmates, even at the cost of a less positive academic self-concept (Dijkstra et al., 2008). However, the pursuit of positive self-evaluation through social comparison does occur during collaborative learning and can influence learning for the worse (Johnson et al., 2007). For example, perceived evaluative pressure can cause students to become distracted by efforts to demonstrate their relative competence, and taking steps to reduce such evaluative pressure improves learning (Buchs et al., 2004; Buchs et al., 2010).

In the context of explanation, an explainer and an explanation recipient often interact with only one another and thus have only one another for comparison. Moreover, the importance of knowledge awareness to effective explanation means that an explainer must have a good understanding of the recipient's knowledge to calibrate his or her explanation appropriately. This means that in explanations provided by a more knowledgeable explainer, relative knowledge will present the explainer with a downward comparison that clearly establishes that explainer's superior knowledge.

A reasonable person might expect that immediately establishing superior relative competence would free explainers from evaluative pressure and would thus allow them to focus on giving a good explanation. However, the apparently unreasonable nature of self-evaluation defense (e.g., Tesser & Smith, 1980) presents a more alarming possibility. If a more knowledgeable explainer was to draw on relative knowledge for self-evaluative social comparison, then that explainer's positive self-evaluation would be undermined by improving the less capable explanation recipient's knowledge. In this case, a more knowledgeable

explainer's self-enhancement motives would actually be better served by explaining little and thus preserving the self-enhancing social comparison provided by their superior relative knowledge.

On the basis of this analysis of social comparison and knowledge awareness in explanation, we predicted that more knowledgeable explainers motivated to self-evaluate through social comparison would react to knowledge awareness by withholding information in their explanations. At the same time, consistent with the established importance of knowledge awareness for effective explanation (Dehler et al., 2011; Engelmann et al., 2009; Nückles et al., 2005; Wittwer et al., 2010), we expected that explanations by more knowledgeable explainers would better match the needs of the person receiving the explanation when the explainer was aware of the recipient's knowledge than when the explainer was not aware of the recipient's knowledge. In other words, we predicted that knowledge awareness would undermine information sharing among people motivated to self-evaluate through social comparison at the same time that knowledge awareness enables effective coordination of explanation content.

We tested this hypothesis in two experiments by staging a collaborative learning task in which participants explained a lesson on the human immune system to a learning partner (actually fictitious) over a computer network. In both experiments, we provided information about the learning partner that made participants appear more knowledgeable than their learning partner, manipulated participants' awareness of their learning partner's knowledge, and then observed the effects of social comparison motives and knowledge awareness on information sharing and on the match between explanation content and recipient knowledge deficit. Experiment 1 provided an initial test of our hypotheses using a dispositional operationalization of social comparison motives. Experiment 2 generalized and refined the results of Experiment 1 by testing our hypotheses with a situational manipulation of social comparison specific to self-enhancement motives and by connecting explainers' information-sharing efforts to performance on a knowledge test.

Study 2.1

Method

Participants and design. Seventy-six students at a German university participated in a Knowledge Awareness (own knowledge only, own knowledge x partner knowledge, or partner knowledge only) x Social Comparison Orientation (continuous) design in exchange for €8 (approximately $10). Five participants expressed suspicion about the experimental

deceptions and so were excluded from analysis, reducing the final sample to 71 participants (14 men, 55 women; mean age = 23.28 years, range = 18–33 years).

Materials. We used a lesson on the human immune system and an accompanying knowledge display adapted from Dehler Zufferey, Bodemer, Buder, and Hesse (2011, see Appendix I for lesson content). The lesson consisted of four parts: an overview of the human immune system, a section on nonspecific immune responses, a section on humoral immune responses, and a section on cellular immune responses. Each of these sections was, in turn, divided into four subsections for a total of 16 lesson sections.

The knowledge awareness manipulation consisted of a graphical knowledge display that differed according to experimental condition. In the *own knowledge only condition*, participants viewed a display of their lesson understanding organized by lesson section and subsection. This display served as our no knowledge awareness control condition. In the *own knowledge + partner knowledge condition*, participants viewed an identically organized display of both their own lesson understanding as well as their learning partner's lesson understanding. This display provided knowledge awareness in an explicitly comparative format. In the *partner knowledge only condition*, participants viewed an identically organized display of only their learning partner's lesson understanding. This display provided knowledge awareness in a format that left comparison with own knowledge implicit.

All displays were constructed by asking participants to mark the sections of the lesson that they understood well enough to explain to their learning partner after studying the lesson. Learning partner responses were generated by randomly subtracting five lesson subsections from the areas that participants indicated they understood so that participants were always more knowledgeable than their learning partner.

Procedure. Participants arrived at the laboratory in groups of up to six people. Participants were told that they would fill out a short personality questionnaire, study a lesson on the human immune system, swap explanations of the lesson with a learning partner (actually fictitious) who they would never meet face-to-face, and then take a knowledge test (also fictitious). Participants received no details about the form or nature of the test. To reinforce the presence of the fictitious learning partner, we assigned participants to Group A on recruitment, there were signs directing Group A and Group B to different locations on arrival, and the experimenter made a fake phone call at the beginning of the experimental session ostensibly to synchronize the time at which the two groups started the experiment.

The experiment began with assessment of participants' social comparison orientation using a validated German translation (Cronbach's α = .76, M = 1.25, SD = 0.65, range = -1.18 - 2.64, scale range = - 3 to + 3) of Gibbons and Buunk's (1999) Iowa–Netherlands Comparison Orientation Measure (Jonas & Huguet, 2008, see Appendix II for items), which participants completed at their own pace. Next, participants began a practice study phase in which participants read the lesson overview and then became familiar with the mechanics of the knowledge display. After the practice phase, participants had 15 min to study the remainder of the lesson, after which they indicated their lesson understanding and saw the main knowledge display. Participants had a pen and paper available if they wished to take notes.

After viewing the main knowledge display, participants were given the opportunity to write an explanation of the lesson for their learning partner. Participants were first asked to indicate which areas of the lesson they intended to explain to their learning partner and were then given up to 15 min to write an explanation of the lesson in a provided text box. In the rare event that participants indicated they would explain no areas of the lesson, they were asked to confirm their response before moving on to the text box. Once participants finished with their explanations, they were asked to complete self-report and demographic items, at which point the experiment ended. Participants were then probed for suspicion about the fictitious nature of their learning partner, fully debriefed, and thanked.

Dependent measures. We assessed three dependent variables. We assessed the match between explanations and learning partner knowledge deficit to ensure that we replicated the established benefits of knowledge awareness. We assessed information sharing through explanation to test our main hypothesis. Finally, we assessed the number of accurately conveyed lesson concepts to support the validity of our measure of information sharing.

Explanation match. The match between participants' explanations and their partners' knowledge deficit was measured with the percentage of match between the areas that participants indicated they would explain and the areas that the learning partner did not understand. The more often explanations matched partner knowledge deficit, the better participants matched their explanations to partner learning needs.

Information sharing. Information sharing was measured with a combined index of the number of lesson elements that participants chose to explain to their learning partner, the time

that participants spent preparing their explanations, the length of the explanation, and participants' self-rated effort in preparing their explanation. Self-rated effort was assessed with a single item on a 7-point scale anchored at 0 (*no effort*) and 6 (*as much effort as possible*). These four components were *Z* standardized and averaged into a single index of information sharing. Cronbach's α was .67 in this experiment and was .74 in pilot work.[2] Higher numbers indicated more information sharing.

Information correctness. Two independent coders counted the number of accurately conveyed lesson concepts contained in participants' explanations. The coders were unaware of all predictor variables. Agreement between the two coders was nearly perfect, $r(69) = .97$, $p < .001$, and discrepancies were resolved by averaging the two coders' counts.

Although the amount of information communicated is already included in the information sharing index (as the amount of text present in explanations), assessing the accuracy of information sharing allowed us to evaluate the possibility that reduced information sharing as we measured it reflected more efficient communication of the same information rather than an actual reduction in the amount of information communicated.

Results

Explanation match

Consistent with past work, we expected that knowledge awareness would facilitate explainers' ability to match their explanation to partner knowledge deficit. Participants understood 9.3 (*SD* = 2.89) out of 16 lesson elements. Five people indicated zero areas of explanation, preventing their inclusion in analysis of explanation match.[3] A one-way analysis of variance (ANOVA) on the percentage of match between explanation and partner knowledge deficit yielded a main effect of condition, $F(2, 61) = 10.00$, $p < .001$, $\eta^2 = .21$.

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[2] We conducted pilot work ($N = 53$), which closely paralleled Experiment 1 while omitting the partner knowledge only condition. In general, the results were parallel to those observed in Experiment 1 but were suggestive rather than definitive. Information sharing showed the same simple effects we report in Experiment 1. People predisposed to social comparison shared less information after knowledge awareness, $\beta = .45$, $p = .021$, and people not predisposed to social comparison showed no such difference, $\beta = -.02$, $p = .926$. The key interaction between social comparison orientation and knowledge awareness did not reach conventional levels of significance, however, $\beta = .36$, $p = .089$. Additionally, the pilot miscalibrated lesson difficulty, which prevented effective assessment of explanation match due to a floor effect in partner understanding. Although these results do not warrant full reporting, we refer to them when they provide useful additional context for interpreting our main findings.

[3] Inferring the reason for this response is difficult. Some of these participants did provide information about the human immune system in their written explanations, whereas others provided short, impoverished communications. Unfortunately, we have no way to determine whether this subset of participants were simply unsure of what they would say beforehand, felt their intended explanation was not about a particular part of the lesson, or had some other intention entirely.

Consistent with predictions, a Student Newman–Keuls post hoc test (α = .05) indicated that participants better matched their explanations to areas of partner deficit in the own knowledge + partner knowledge condition (*M* = 77.9%, *SD* = 30.61%) and in the partner knowledge only condition (*M* = 91.0%, *SD* = 25.23%) than in the own knowledge only condition (*M* = 59.5%, *SD* = 30.08%). In other words, both forms of partner knowledge awareness enabled participants to more effectively match their explanations to areas of partner knowledge deficit. Social comparison orientation did not moderate these results, $\Delta R^2 = .012$, $p = .621$.

Information sharing

Information sharing is graphed by condition and social comparison orientation in Figure 1. We predicted that people high in social comparison orientation would share less information when they were aware of partner knowledge than when they were not aware of partner knowledge, regardless of how partner knowledge was displayed.

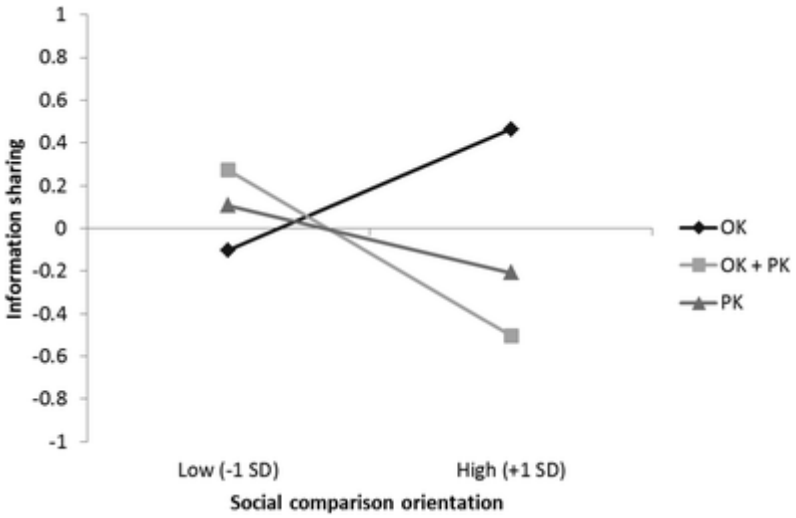

Figure 1. Information sharing in the own knowledge condition (OK), in the own knowledge + partner knowledge condition (OK + PK) and in the partner knowledge condition (PK) by social comparison orientation, Experiment 1. Zero represents the average amount of information sharing across all participants.

We assessed the omnibus interaction between knowledge awareness and social comparison by representing knowledge awareness with two orthogonal contrasts, entering those contrasts and social comparison orientation into a hierarchical regression equation on Step 1, entering the interaction between the contrasts and social comparison orientation on Step 2, and observing the change in R^2 between Step 1 and Step 2 of the regression equation (J. Cohen, Cohen, West, & Aiken, 2003). A significant change in R^2 between Step 1 and Step 2 would indicate an omnibus interaction. Note that because this approach focuses on the change in the explanatory power of the whole equation rather than on specific terms, all

possible sets of orthogonal contrasts are interchangeable and equally viable. The specific contrasts we used (provided only for comprehensive reporting) compared the own knowledge only condition with the own knowledge + partner knowledge and partner knowledge only conditions in Contrast 1 (coded −2 1 1) and ignored the own knowledge only condition while comparing the own knowledge + partner knowledge and partner knowledge only conditions in Contrast 2 (coded 0 −1 1). Step 1 of this analysis revealed no significant effects. Neither social comparison orientation, $\beta = -.10$, $p = .422$; Contrast 1, $\beta = .19$, $p = .127$; nor Contrast 2, $\beta = .06$, $p = .597$, predicted information sharing. Of more theoretical interest, Step 2 revealed a significant Social Comparison Orientation × Knowledge Awareness interaction, $\Delta R^2 = .10$, $F(2, 63) = 3.70$, $p = .030$.

We examined the influence of knowledge awareness on people relatively high and relatively low in social comparison orientation by shifting social comparison orientation one standard deviation above and below its mean and by examining each possible pairwise comparison of the knowledge awareness conditions (entered into the regression equation with all necessary companion terms) at these different levels of social comparison orientation (J. Cohen et al., 2003). Note that this procedure is fully analogous to probing an interaction with simple comparisons in an ANOVA framework. Consistent with predictions, people predisposed to self-evaluate through social comparison shared less information in both the own knowledge + partner knowledge condition, $\beta = .54$, $p = .005$, and the partner knowledge only condition, $\beta = .40$, $p = .019$, than in the own knowledge only condition. Information sharing did not differ significantly between the own knowledge + partner knowledge condition and the partner knowledge only condition, $\beta = .17$, $p = .356$. People low in social comparison orientation showed no such differences in information sharing. Among these participants, information sharing did not differ between the own knowledge only condition and either the own knowledge + partner knowledge condition, $\beta = -.23$, $p = .306$, or the partner knowledge only condition, $\beta = -.13$, $p = .423$. Similarly, information sharing did not differ between the own knowledge + partner knowledge and the partner knowledge only conditions, $\beta = -.10$, $p = .635$. These results indicate that people predisposed to social comparison shared less information when made aware of partner knowledge, even when visual display of partner knowledge did not encourage such comparison.[4] People not

[4] Inspection of Figure 1 also suggests that without knowledge awareness, people predisposed to social comparison tended to share more information. However, the statistical test of this relationship was ambiguous, $\beta = .40$, $p = .085$. In our pilot work, the same slope was nonsignificant, $\beta = -.02$, $p = .923$. Were such a relationship present, it might be consistent with people predisposed to social comparison attempting to construct a favorable comparison in the absence of existing knowledge awareness by displaying their knowledge through explanation. Similar inspection of the slopes of social comparison orientation in the knowledge awareness conditions suggests that with

predisposed to self-evaluate through social comparison, however, did not change the amount of information they shared as a result of knowledge awareness.

Information correctness

On average, participants' explanations contained 9.06 (*SD* = 4.70) accurate lesson concepts. The number of accurately explained lesson concepts was strongly correlated with our broader index of information sharing, $r(69) = .66$, $p < .001$. Extended analysis of the number of accurately explained lesson concepts (identical to that used for information sharing) revealed a pattern parallel to that observed for the broader index of information sharing. Step 1 of the analysis revealed a significant comparison between the own knowledge only condition and the own + partner knowledge and partner knowledge only conditions, $\beta = .29$, $p = .015$, while neither social comparison orientation, $\beta = -.12$, $p = .318$, nor the comparison of the own + partner knowledge and partner knowledge only conditions, $\beta = .00$, $p = .996$, was significant. More importantly, Step 2 indicated that social comparison orientation interacted with knowledge awareness, $\Delta R^2 = .12$, $F(2, 63) = 5.03$, $p = .009$. People predisposed to social comparisons communicated fewer accurate lesson concepts in the own knowledge + partner knowledge condition, $\beta = .73$, $p < .001$, and in the partner knowledge only condition, $\beta = .46$, $p = .005$, relative to the own knowledge only condition. Accurate lesson concepts did not differ between the two partner knowledge awareness conditions, $\beta = .26$, $p = .143$. No such relationships emerged for people not predisposed to social comparison. Among these participants, neither the own knowledge + partner knowledge condition, $\beta = -.30$, $p = .157$, nor the partner knowledge only condition, $\beta = .05$, $p = .759$, differed from the own knowledge only condition, and the partner knowledge awareness conditions did not differ from one another, $\beta = -.34$, $p = .086$. These results clearly indicate that the effects of predisposition on social comparison and knowledge awareness on information sharing (as we measured it) corresponded to accurate information in explanations.

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knowledge awareness, the more people are predisposed to social comparison, the less information they tend to share. A contrast (orthogonal to the comparison reported above) comparing both of the knowledge awareness conditions with the control condition yielded a significant negative relationship between predisposition to social comparison and information sharing in the presence of knowledge awareness, $\beta = -.27$, $p = .049$. In our pilot work, the simple slope of the knowledge awareness condition was also negative and significant, $\beta = -.53$, $p = .014$. Thus, simple slopes analysis of predisposition to social comparison were ambiguous regarding the relationship between predisposition to social comparison and information sharing without knowledge awareness but indicated that with knowledge awareness, people predisposed to social comparison elaborated less. Although interesting and generally consistent with our hypotheses, these analyses are of secondary importance to the direct comparison of the effects of knowledge awareness on information sharing among people differentially predisposed to social comparison. Comparison of knowledge awareness conditions at different levels of social comparison orientation provides the most germane test of hypotheses about the effects of knowledge awareness for different types of people.

Note that mediational analysis (although statistically supportive of mediation if completed) is not meaningful under these circumstances. The number of correctly communicated lesson concepts is conceptually closer to a subset of information sharing than to a distinct outcome.

Discussion

Experiment 1 provided strong evidence for our hypothesis. Knowledge awareness allowed explainers to better match their explanations to a learning partner's knowledge deficit, but, at the same time, knowledge awareness reduced information sharing among explainers predisposed to self-evaluate through social comparison. Moreover, parallels between information sharing (as measured here) and the number of accurate lesson concepts contained in participants' explanations (as assessed by objective coding of participants' responses) ruled out the possibility that participants who shared less information were simply communicating the same information more efficiently. Instead, it appears that the information communicated by participants was accurate and that, when present, that information would thus provide explanation recipients with a resource for learning. Although this outcome is not a necessary derivation under our hypotheses (i.e., participants could have attempted to share accurate information but failed), the convergence between information sharing as we measure it and the amount of accurate information communicated supports the validity of our measure of information sharing.

However, we saw several important limitations on the interpretation of these results. In this experiment, we operationalized social comparison motives dispositionally. The measure of predisposition to social comparison that we used is well validated, but one might still ask if other unmeasured but related dispositional factors might account for our findings. Moreover, social comparison orientation is a domain-general predisposition to draw on social comparison for self-evaluation (Gibbons & Buunk, 1999), whereas our hypothesis draws on social comparison in the specific domain of self-enhancement. Replicating our findings with situationally motivated social comparison specific to self-enhancement would increase confidence that we are accurately characterizing the motives at play in Experiment 1 and also bolster the generalizability of our results. In addition, although our measure of information sharing reflected the communication of accurate information in this experiment, a second important characteristic of explanation is that providing explanations improves explainer understanding (Webb, 1989, 1991;Webb & Mastergeorge, 2003; Webb et al., 1995). A

connection between information sharing as we measure it and explainer understanding would thus further bolster confidence in our measure of information sharing's validity.

Study 2.2

Experiment 2 replicated the previous experiments with two main changes. In Experiment 2, we used a situational manipulation of social comparison motives and included a knowledge test at the end of the procedures.

In Experiment 2, we manipulated social comparison motives by giving participants negative feedback, positive feedback, or no feedback about their performance on an intelligence test taken before the main experimental task. Receiving negative feedback about intelligence constitutes threatening self-evaluative information to most students. A common and effective way to cope with such threatening information is to find or construct a downward social comparison to bolster positive self-evaluation (Helgeson & Mickelson, 1995; Taylor & Lobel, 1989; Tesser, 1988). For example, coping with health threats through downward social comparison supports positive self-evaluation and improves mental well-being in cancer patients and cardiac patients (Helgeson & Taylor, 1993; Wills, 1981). On the basis of this past work, we expected negative intelligence feedback to motivate the use of the downward comparison standard presented by knowledge awareness. In contrast, positive or no feedback presents no such threat and thus would not be expected to motivate downward comparison. We included a no feedback condition in addition to a positive feedback condition to verify that social comparison arose as a result of threat rather than being suppressed as a result of self-evaluative reassurance.

An important strength of this particular manipulation of social comparison is that it is specific to self-enhancement through downward social comparison, the subset of social comparison motives that we propose explain the results of Experiment 1. Whereas social comparison orientation is a general predisposition to rely on social comparison for self-evaluation (Gibbons & Buunk, 1999), negative feedback prompts social comparison only when such comparison provides a self-evaluative counterbalance to the evaluative implications of negative feedback (Fein & Spencer, 1997; Tesser, 1988; Wills, 1981). Thus, if negative intelligence feedback produces results parallel to Experiment 1, it would not only generalize our findings beyond individual predispositions but would also support a self-enhancement account of Experiment 1.

Adding a knowledge test at the end of the procedures allowed examination of explainer understanding, in turn allowing us to better validate our measure of information sharing. One of the established benefits of explanation is an improvement in explainer understanding of the material explained (Webb, 1989, 1991). Explainer understanding provided a good validational outcome because improvements in understanding are directly related to the mental work done in formulating explanations with no or few intervening causal steps that might distort the relationship.

Note that knowledge awareness and the attendant adaptation of explanations to partner knowledge can also improve explainer understanding (Dehler Zufferey et al., 2011). Thus, the effects of reduced information sharing might manifest by eliminating the positive effects of knowledge awareness rather than by reducing explainer understanding relative to no knowledge awareness. Regardless of the particular relationship between knowledge awareness and explainer learning, we predicted that reduced information sharing resulting from the combination of social comparison motives and knowledge awareness would, in turn, reduce explainer understanding relative to conditions of knowledge awareness in which social comparison motives were absent.

Method

Participants and design

One hundred twenty-six students at a German university participated in a 2 (knowledge awareness: own knowledge only or partner knowledge only) × 3 (feedback: positive feedback, no feedback, or negative feedback) design in exchange for €12 (approximately $15). Eight participants expressed suspicion about experimental deceptions and were therefore excluded from analysis, reducing the final sample to 118 participants (45 men, 73 women; mean age = 23.22 years, range = 19–37 years).

Procedure

The procedure paralleled that of Experiment 1 with the following exceptions. First, we removed the own knowledge + partner knowledge condition while retaining the own knowledge only and partner knowledge only awareness conditions. Comparison of these two conditions provided the most stringent tests of our hypotheses. Second, we added an intelligence test and associated feedback as well as a knowledge test to assess learning outcomes. Reliability for the knowledge-sharing index was again acceptable and comparable to that of Experiment 1 and pilot work, Cronbach's $\alpha = .69$.

Intelligence feedback. At the beginning of the experimental session, participants completed a shortened paper-and-pencil version of the German Intelligence-Structure-Test 2000 R (Liepmann, Beauducel, Brocke, & Amthauer, 2007). Participants were given 10 min to work on the test. In the negative feedback and positive feedback conditions, participants received performance information directly before viewing the main knowledge display and providing an explanation to their learning partner. In the negative feedback condition, participants were told that they scored in the 47th percentile of their age group and that their intellectual ability was thus average. Note that average intellectual ability is regarded as quite negative in university populations (Fein & Spencer, 1997). In the positive feedback condition, participants were told that they scored in the 95th percentile of their age group and that their intellectual ability was thus outstanding. Participants in the no feedback condition did not expect or receive a test score at all. By threatening participant self-evaluation in the negative feedback condition (but not in the positive and no feedback conditions), we expected to motivate the use of compensatory social comparison in the negative feedback condition but not in the positive and no feedback conditions (Helgeson & Mickelson, 1995; Helgeson & Taylor, 1993; Taylor & Lobel, 1989; Tesser, 1988; Wills, 1981).

Knowledge test. We added a knowledge test (adapted from Dehler Zufferey et al., 2011, see Appendix III for items) at the end of the experiment to assess learning outcomes. Maintaining the illusion of a learning partner in combination with the knowledge test required that participants received an explanation from their learning partner after they completed their explanation. Immediately before the knowledge test, participants received an explanation that said only that the learning partner did not feel able to explain anything to the participant.

The test consisted of 10 multiple-choice items with four main options and a fifth “none of the above” option. Multiple correct responses were possible for each item, resulting in a total score out of 17 correct answers.

Results

Explanation match

Consistent with previous work, we expected that participants who were aware of partner knowledge would better match their explanations to areas of partner knowledge deficit than would participants who were not aware of partner knowledge. Six people indicated zero areas of explanation, preventing their inclusion. A two-way ANOVA on the percentage of

match between explanation and partner knowledge deficit yielded only a main effect of knowledge awareness, $F(1, 106) = 56.05$, $p < .001$, $\eta^2 = .34$. Participants in the partner knowledge awareness conditions matched their explanations better to partner knowledge deficit ($M = 89\%$, $SD = 24.67\%$) than did participants in the own knowledge conditions ($M = 53.58\%$, $SD = 23.31\%$). Explanation match did not differ significantly between the negative, positive, and no feedback conditions, $F(2, 106) = 0.31$, $p = .735$, $\eta^2 = .00$, and the interaction between knowledge awareness and feedback was not significant, $F(2, 106) = 0.43$, $p = .650$, $\eta^2 = .01$. These results indicate that partner knowledge awareness facilitated participants' ability to match their explanation to areas of partner knowledge deficit.

Information sharing

Information sharing is graphed by knowledge awareness and feedback condition in Figure 2. We predicted that awareness of partner knowledge would prompt people who received negative feedback to withhold knowledge but that knowledge awareness would not affect information sharing after positive feedback or after no feedback. A 2 (knowledge awareness: own knowledge or partner knowledge) × 3 (feedback: positive, none, or negative) ANOVA yielded a significant main effect of knowledge awareness condition, $F(1, 112) = 4.90$, $p = .029$, $\eta^2 = .04$, and a significant main effect of feedback condition, $F(2, 112) = 5.33$, $p = .006$, $\eta^2 = .08$, both of which were qualified by the predicted Knowledge Awareness × Feedback interaction, $F(2, 112) = 3.73$, $p = .027$, $\eta^2 = .06$. Simple comparison of the effects of knowledge awareness at different levels of feedback indicated that, as expected, partner knowledge awareness ($M = -.686$, $SD = .49$) reduced information sharing relative to own knowledge awareness ($M = .078$, $SD = .74$) after negative feedback, $F(1, 112) = 12.77$, $p < .001$, $\eta^2 = .10$. Information sharing after positive feedback was comparable after partner knowledge awareness ($M = .102$, $SD = .79$) and after own knowledge awareness ($M = .047$, $SD = .63$), $F(1, 112) = 0.06$, $p = .812$, $\eta^2 = .00$. Similarly, information sharing after no feedback was comparable after partner knowledge awareness ($M = .178$, $SD = .68$) and after own knowledge awareness ($M = .153$, $SD = .58$), $F(1, 112) = 0.01$, $p = .907$, $\eta^2 = .00$. Thus, among participants who first received negative intelligence feedback, knowledge awareness reduced information sharing. Among participants who received positive or no feedback, however, knowledge awareness did not reduce information sharing.

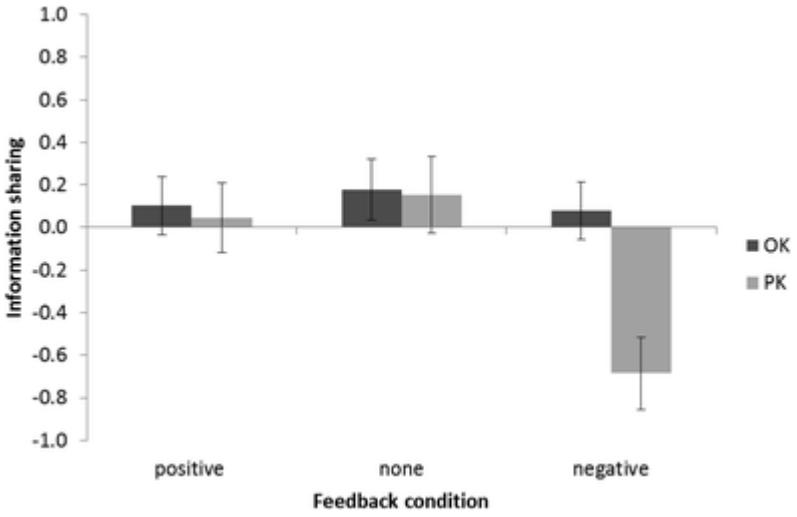

Figure 2. Information sharing after own knowledge (OK) and partner knowledge (PK) awareness by intelligence feedback in Experiment 2. Error bars represent cell standard errors. Zero represents the average amount of information sharing across all conditions.

Knowledge test

We predicted that reduced information sharing resulting from the combination of negative feedback and knowledge awareness (observed above) would, in turn, hurt learning outcomes as measured by knowledge test performance. This hypothesis implies two testable elements: (a) that intelligence feedback should moderate the effects of knowledge awareness on test performance and (b) that the effects of intelligence feedback and knowledge awareness on information sharing should at least partially account for the effects of intelligence feedback and information sharing on learning outcomes.

We examined the first of the elements, the relationship between intelligence feedback, knowledge awareness, and test performance, in a standard ANOVA. These relationships are graphed in Figure 3. We expected negative feedback to reduce or reverse the beneficial effects of knowledge awareness in the positive and no feedback conditions. The 2 × 3 ANOVA revealed only the predicted interaction between knowledge awareness and feedback condition, $F(2, 112) = 4.87$, $p = .009$, $\eta^2 = .08$. Neither the main effect of intelligence feedback, $F(2, 112) = 2.21$, $p = .114$, $\eta^2 = .04$, nor knowledge awareness, $F(1, 112) = 2.46$, $p = .120$, $\eta^2 = .02$, was significant. Among people who received negative feedback, partner knowledge awareness ($M = 6.06$, $SD = 3.01$) tended to hurt learning outcomes relative to awareness of own knowledge only ($M = 7.42$, $SD = 3.08$), $F(1, 112) = 2.35$, $p = .129$, $\eta^2 = .02$. However, after both positive and no feedback, partner knowledge awareness had the opposite effect on

learning. Among people who received positive feedback, partner knowledge awareness (M = 7.29, SD = 2.61) tended to help learning outcomes relative to own knowledge awareness (M = 5.91, SD = 2.31), $F(1, 112) = 2.07$, $p = .153$, $\eta^2 = .02$, and among people who received no feedback, partner knowledge awareness (M = 9.10, SD = 3.28) similarly helped learning outcomes relative to own knowledge awareness (M = 6.60, SD = 2.52), $F(1, 112) = 7.56$, p = .007, $\eta^2 = .06$.[5] Note that the large difference between the knowledge awareness conditions after no feedback is not the primary driver of this interaction. A focused test of the interaction between knowledge awareness and just the negative feedback and positive feedback conditions was also significant, $F(1, 112) = 4.40$, $p = .038$, $\eta^2 = .04$, whereas a similar test using just the positive feedback and no feedback conditions was not, $F(1, 112) = 0.69$, p = .410, $\eta^2 = .01$. As predicted, the combination of negative feedback and knowledge awareness reversed the positive effects of partner knowledge awareness on test performance found in the positive and no feedback conditions.

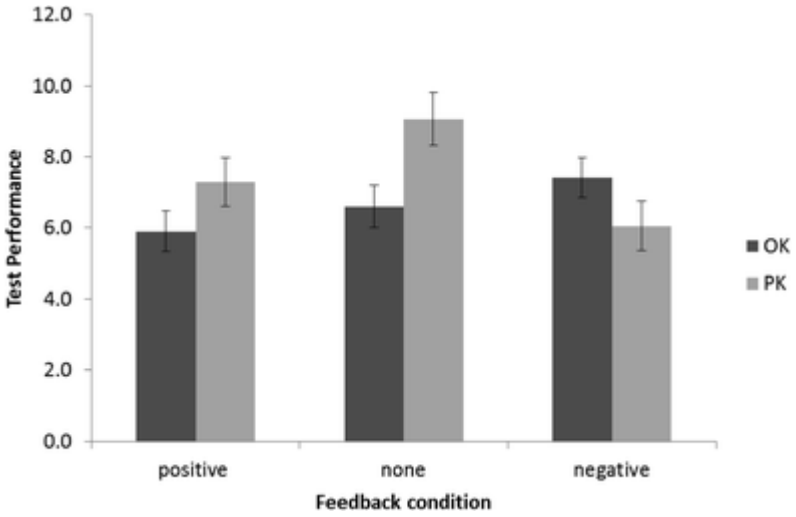

Figure 3. Knowledge test performance after own knowledge (OK) and partner knowledge (PK) awareness by intelligence feedback in Experiment 2. Error bars represent cell standard errors.

As a second step in our analysis, we assessed the ability of the interaction between feedback and knowledge awareness on information sharing to account for the same interaction in test performance (mediated moderation). This analysis is graphed in Figure 4. Conceptually, our analysis followed the classic Baron and Kenny (1986) approach to mediation. In trying to explain test performance, we began with the established direct effect on test performance of the interaction between intelligence feedback and knowledge

[5] Analysis controlling for potential response bias, accomplished by including responses to the distractors as a covariate, yields convergent results.

awareness. We then verified that our proposed mediator (information sharing) also predicted test performance. And last, we assessed the changes in these relationships when simultaneously predicting test performance from the interaction between intelligence feedback and knowledge awareness and from information sharing. In this final step, we observed that the relationship between the interaction and test performance weakened while the relationship between information sharing and learning outcomes remained intact, an outcome supportive of mediation. The specific computations used to capture these relationships are described in detail below.

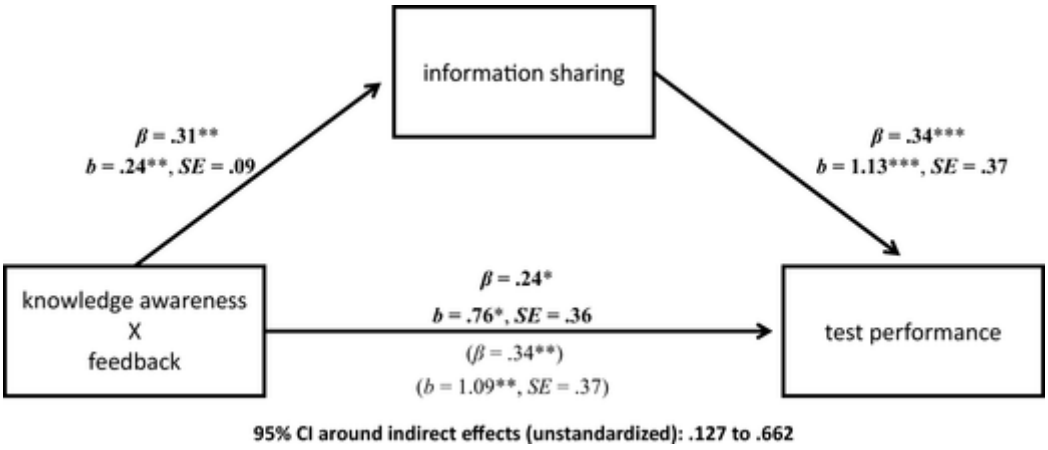

Figure 4. Mediational analysis in Experiment 2 using the interaction between knowledge awareness and feedback in information sharing to account for the same interaction in test performance. Bold text denotes relationships with all factors entered together. Nonbold text parentheses denotes the relationship between interaction and test performance before accounting for information sharing. *$p < .05$. **$p < .01$. $p < .001$.

Because the feedback manipulation had three levels, mediational analysis of the interaction between knowledge awareness and feedback condition required representing feedback condition with two orthogonal contrasts and assessing mediation at the level of particular contrasts (J. Cohen et al., 2003). Fortunately, our hypotheses and observed results are well represented by a focal contrast comparing the negative feedback condition with the positive and no feedback conditions (with respective contrast weights of −2 1 1) and a supplementary contrast comparing the positive feedback and no feedback conditions (with respective contrast weights of 0 −1 1). This focal contrast reflects the prediction that the positive and no feedback conditions would behave similarly to one another but differently from the negative feedback condition. The supplementary contrast is an uninteresting technical necessity under these particular circumstances. An interaction between the focal contrast and the knowledge awareness manipulation effectively captures the essence of our hypotheses and our observed results with respect to both information sharing and learning

outcomes; we expected the positive feedback and no feedback conditions to behave differently from the negative feedback condition only in combination with knowledge awareness. Consistent with our ANOVA-based analysis, the interaction between the focal contrast and the knowledge awareness manipulation was significant when predicting both information sharing, $\beta = .31$, $p = .008$, and learning outcomes, $\beta = .34$, $p = .004$, thus meeting the traditional preconditions of mediational analysis (Baron & Kenny, 1986).

To assess the extent to which information sharing could account for the interaction between feedback and knowledge awareness in determining knowledge test performance, we conducted a three-step hierarchical regression predicting test performance. On Step 1, we entered the orthogonal contrasts representing the feedback manipulation and the knowledge awareness manipulation (coded 0 and 1, respectively). On Step 2, we entered the interactions between the contrasts and knowledge awareness. On Step 3, we entered information sharing. Critically, the addition of knowledge sharing on Step 3 reduced the strength of the focal Knowledge Awareness × Feedback interaction reported above, $\beta = .24$, $p = .037$, while the relationship between information sharing and test performance remained strong and significant, $\beta = .34$, $p < .001$. This pattern is consistent with mediation (Muller, Judd, & Yzerbyt, 2005).

To provide further support for our hypothesis, we formally tested the reduction in the relationship between the manipulations and knowledge test performance. We used bootstrapping with 1,000 resamples to construct asymmetrical, bias corrected, accelerated 95% confidence intervals (MacKinnon, Lockwood, & Williams, 2004; Preacher & Hayes, 2008) around the unstandardized indirect effects of the Knowledge Awareness × Feedback interaction and our measure of knowledge sharing on learning outcomes. The resulting 95% confidence interval [.13, .66] did not contain zero, which is equivalent to significance at $p < .05$ in an inferential test of indirect effects. Consistent with hypotheses, these analyses suggests that the interaction between knowledge awareness and feedback in information sharing can partially account for the same interaction in learning outcomes.

In sum, these data suggest that, as predicted, withholding information in response to the combination of social comparison motives and knowledge awareness in turn harmed explainer understanding of the material they did not explain. By withholding information, explainers deprived themselves of a useful learning experience. In addition to its practical importance, the connection between information sharing and test performance supports our measure of information sharing's validity.

Discussion

Experiment 2 provided a second demonstration that when the social comparison presented by knowledge awareness is used for self-evaluation, knowledge awareness can undermine knowledge sharing at the same time that it facilitates explanation match. These results were obtained with a situational manipulation of self-enhancing comparison motives and connected information sharing, as measured here, with performance on a knowledge test. That we observed parallel results between dispositionally motivated social comparison and situationally motivated social comparison specific to self-enhancement supports the generalizability of these findings, supports the role of self-enhancement motives in explaining these findings, and increases confidence that the effects of predisposition on social comparison are not confounded with some other dispositional trait. That we observed parallel results in information sharing and knowledge test performance connects the effects of knowledge awareness and social comparison motives on information sharing to an important downstream consequence of providing explanations. In sum, Experiment 2 indicated that the relationship between social comparison motives, knowledge awareness, and information sharing is robust across operationalizations, is specific to self-enhancement, and has important consequences for successful or unsuccessful explanation.

General discussion of Chapter 2

Two experiments provided convergent evidence about the mixed costs and benefits of knowledge awareness. In both experiments, knowledge awareness was necessary for explainers to effectively match their explanations to explanation recipients' needs. However, at the same time that knowledge awareness enabled people to effectively target their explanations, knowledgeable explainers motivated to engage in social comparison shared less information as a result of knowledge awareness. In short, these results demonstrate that knowledge awareness allows explainers to determine what needs to be explained but, when social comparison motives become involved, knowledge awareness can simultaneously rob resulting explanations of content.

This tension between explanation matching and information sharing identifies a potentially serious barrier to effective explanation. A lengthy explanation that a recipient does not actually need or cannot understand will not provide effective support to an explanation recipient, although it might very well benefit the explainer (Webb, 1989, 1991). However, if an explainer does not provide any substance in a matched explanation, no one will benefit

from that explanation. Thus, effectively managing social comparison motives might be key to effective explanation.

Across both studies, social comparison motives had no effect at all on explainers' message matching to partner knowledge deficit. That is, explainers addressed the topics that recipients did not understand even when the amount of information conveyed varied as a consequence of social comparison motives. This might appear surprising as our hypothesis about information sharing could be reformulated to predict strategic mismatch between an explanation recipient's needs and explanation content. We did not expect this relationship to emerge because the effects of knowledge awareness on information match appear reliable in past work (e.g., Dehler et al., 2011; Engelmann et al., 2009; Nückles, et al., 2005; Wittwer et al., 2010; Dehler Zufferey et al., 2011) and because of the normative nature of shared understanding.

By the normative nature of shared understanding, we mean that acknowledging information about another person's knowledge is intrinsic to the basic rules of conversation and to the shared experience of reality (Clark & Brennan, 1991; Echterhoff, Higgins, & Levine, 2009). Violating a shared framework of understanding is thus uncomfortable and strange. Solomon Asch's (1955) classic experiments on conformity provide some insight into such violations. In Asch's experiments, participants experienced a group of people unanimously constructing a version of reality that directly contradicted participants' own senses. Participants' subjective experience of these circumstances involved great discomfort, and participants often distorted their responses to be consistent with the group consensus. In the context of explanation, a comparable example would be providing someone with an explanation of arithmetic multiplication when that person had just unambiguously stated that he or she understood multiplication but was struggling with division. Such behavior would appear strange and feel uncomfortable to most people in a way that providing a poor explanation of division would not. Of course, in situations with more ambiguity surrounding explanation recipient knowledge, strategic misunderstanding of recipient knowledge by an explainer might indeed arise.

In another vein, one might ask if less cynical alternatives to self-enhancement might also explain these data. For example, perhaps these results reflect differences in working memory or confidence rather than motivated action. Or perhaps explainers motivated to engage in social comparison and confronted with knowledge awareness provided less information so as to provide a better and more focused explanation. Although these

alternative explanations might account for one aspect of our findings, they cannot account for our findings in their entirety.

Working memory or confidence might vary with social comparison orientation or might be affected by negative intelligence feedback. A parsimonious account of why those differences would manifest only in the presence of knowledge awareness, however, is difficult to articulate. Similarly, a better and more focused explanation might be consistent with using fewer words, one element of how we measured reduced information sharing, but would not be consistent with additional elements of the measure, namely, using less time and reporting less effort in constructing that writing. Making writing more focused, clear, and concise is challenging (Bem, 2003; Strunk & White, 1999) and would thus most likely increase rather than decrease the time and effort devoted to that writing. Moreover, we can find no compelling explanation of why both social comparison orientation and negative intelligence feedback would prompt more focused and concise explanations in response to a downward comparison presented by knowledge awareness.

In this work, we focused on knowledgeable explainers' efforts to share information rather than explanation recipients' understanding of information. This focus allowed close examination of explainers' attempts at information sharing unobscured by complicating factors such as the explainer's ability to communicate information clearly or a recipient's motivation and strategies to learn from explanation. With this focus, we do not imply that these additional factors are uninteresting. On the contrary, we intend to examine explanation recipients' reactions to knowledge awareness and to explanations from explainers with different social comparison motives in future investigations. We focused on explainers' efforts at information sharing in isolation from recipient variables here to build a clear foundation of knowledge for such future work.

In this work, we used an experimental approach with all of the accompanying advantages and disadvantages. Tightly controlled laboratory conditions allowed us to construct constant differences in explainer and recipient understanding as well as to isolate knowledge awareness and social comparison motives from one another. These circumstances in turn allowed us to clearly examine the relationship between social comparison motives and knowledge awareness in influencing explainers' explanations. Of course, such experimental control comes at a cost. As with any research conducted in the artificial environment of a laboratory, it is reasonable to wonder if our observations will generalize to naturalistic contexts, for example, face-to-face collaborative learning in classroom settings or organizational training contexts. Precedents in related research suggest that our observations

will most likely generalize. Buchs et al. (2010), for example, documented competitive motives in face-to-face collaborative learning related to a university course. Similarly, life and work in organizations is rife with other examples of strategic management of knowledge and knowledge sharing (De Dreu, Nijstad, & van Knippenberg, 2008; Wittenbaum, Hollingshead, & Botero, 2004). However, empirical confirmation of this expectation remains an important avenue for future research.

Equally important is the question of whether these results would generalize to various specific forms of collaborative learning. The form of collaborative learning ranges from relatively unstructured (as implemented here) to heavily structured along different guiding principles. For example, social cohesion approaches aim to build cohesion among collaborating students (Johnson & Johnson, 1990; O'Donnell & O'Kelly, 1994; Slavin, 1996), whereas other techniques, such as reciprocal teaching or the jigsaw classroom, assign roles to encourage both knowledge awareness and information sharing (Aronson, Blaney, Stephan, Sikes, & Snapp, 1978; Palinscar & Brown, 1984).

These types of structured collaborative learning might very well impact social comparison processes in positive ways. For example, team building might result in an inclusive mental representation of collaboration partners and structured roles might provide an alternative means or an alternative set of criteria for self-evaluation. Both modern and classical theory on social comparison suggests that either of these outcomes might solve the problems presented by social comparison in collaborative learning (Brewer & Gardner, 1996; Festinger, 1954). However, the detrimental comparison processes from which we derived our hypotheses were first observed between friends who knew and liked each other (Tesser & Smith, 1980) and, even in structured learning, comparison of relative competencies is still likely (Buchs et al., 2004, 2010). Thus, the potential for problematic social comparison in existing structured collaborative learning techniques remains an important issue for future research.

Beyond an educational context, the central importance of knowledge awareness to transactive memory suggests another fruitful starting point for future investigation. Knowledge awareness is at the heart of transactive memory. Groups using transactive memory have a shared understanding of one another's own areas of expertise (a shared directory) and otherwise specialize in their own knowledge areas so that informational burdens are distributed throughout the group (Brandon & Hollingshead, 2004; Hollingshead, 2001; Wegner, 1987). Such a system emphasizes the value derived from unique knowledge and thus might exacerbate strategic withholding of knowledge in cases where some

redundancy might be desirable, for example, to hedge against personnel loss. The combination of knowledge awareness and comparative evaluation based on unique knowledge might thus push groups toward greater specialization whether or not that specialization is optimal. Alternatively, the combination of comparative self-evaluation and knowledge awareness might disrupt directory updating, the process of revising shared representations of group knowledge. When a group member gains new information about the group's distributed expertise, strategic hoarding of that information might be one strategy with which to enhance one's comparative value. Similarly, the process of transmitting shared knowledge to a new group member might be closely analogous to the information-sharing scenario used in these experiments. Withholding the shared representation of group knowledge from a new group member might effectively undermine that member's performance and thus create a self-enhancing comparison.

Transactive memory is not the only additional area of human behavior that these findings might illuminate. Knowledge awareness plays a central role in many domains of human interaction. The tendency to use one's own current knowledge to infer knowledge in other people characterizes a broad range of human behavior (the so-called curse of knowledge). The biasing impact of this heuristic has been documented in areas as diverse as marketing decisions and day-to-day conversation (Camerer et al., 1989; Keysar & Henly, 2002). To the extent that knowledge awareness is necessary to overcome any such bias, the potential for social comparison will also be introduced. Although the specific influence of social comparison is likely very different across these situations, the core dynamic between the metacognitive benefits of knowledge awareness and the use of knowledge awareness for social comparison likely holds across a wide cross-section of human thought and behavior.

Summary and Conclusion

Explainer awareness of an explanation recipient's existing knowledge is prerequisite to effective explanation. This fact is evident in both the results reported here as well as in previous work on the subject (Engelmann et al., 2009; Nückles et al., 2005; Wittwer et al., 2010). However, at the same time that knowledge awareness allows explainers to match their explanations to recipient understanding, it introduces the potential for social comparison between the explainer and the explanation recipient. This work demonstrates that this opportunity for social comparison can be damaging. We observed that the combination of social comparison motives and knowledge awareness reliably undermined the explanation by prompting explainers to withhold information at the same time that knowledge awareness enabled better explanation match to a recipient needs. Recognizing the harmful role of social

comparison and finding means to manage such comparison processes represent important avenues by which the efficacy of explanation might be improved.

Chapter 3: When being worse helps: The influence of upward social comparisons and knowledge awareness on learner engagement[6]

Knowledge exchange between peers is prevalent at all levels of education (Johnson et al., 2007). Such exchange can enhance learning by creating socio-cognitive conflicts in learners confronted with different opinions or knowledge levels than their own (Doise & Mugny, 1984). The resolution of such conflicts, in turn, creates more elaborate knowledge structures (Fischer et al., 2002). Knowledge exchange is facilitated by externalization of knowledge differences, internalization of shared knowledge, as well as knowledge elaboration and elicitation (Fischer et al., 2002; King, 1992; Webb, 1989; Webb & Palincsar, 1996).

Less knowledgeable learners especially benefit from knowledge exchange if they request and receive explanations that fit their learning needs (Crommelinck & Anseel, 2013). However, learners often do not spontaneously seek and provide effective help (Cohen, 1994; Fischer & Mandl, 2005; Kreijns et al., 2003; Pelgrim, Kramer, Mokkink, & van der Vleuten, 2012). One reason for such difficulty is that people are generally biased in their inference of another person's knowledge; people tend to assume that another person's knowledge is similar to their own (Fischer et al., 2002). Such problems are exacerbated if social and contextual cues that naturally occur in face-to-face interactions, for example nodding and rapid verbal exchanges, are missing, as in computer-supported learning settings (e.g. Clark & Brennan, 1991; Janssen et al., 2007; Kiesler et al., 1984; Kraut, Fussell, Brennan, & Siegel, 2002). Consequently, people might fail to request explanations appropriate to a learning partner's knowledge level and might thus fail to elicit satisfying feedback (Birch & Bloom, 2007; Camerer et al., 1989; Fussell & Krauss, 1992; Nickerson, 1999; Pelgrim et al., 2012; Wittwer & Renkl, 2008).

Studies of computer-supported collaborative learning suggest a way to overcome these difficulties - making learners aware of what each learning partner actually knows. We term this state of understanding *knowledge awareness* (Sangin, Molinari, Nüssli, & Dillenbourg, 2011). Once established, knowledge awareness enables learners to better match explanation and help-seeking to a partner's knowledge level and facilitates better learning outcomes (e.g. Bodemer & Dehler, 2011; Dehler et al., 2011; Sangin et al., 2011). In fact, one advantage of

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[6] This chapter has been published in the following article:
Neugebauer, J., Ray, D. G., & Sassenberg, K. (2016). When being worse helps: The influence of upward social comparisons and knowledge awareness on learner engagement and learning in peer-to-peer knowledge exchange. Learning and Instruction, 44, 41–52. doi:10.1016/j.learninstruc.2016.02.007

computer-supported collaborative learning over face-to-face collaborative learning is that knowledge awareness can be explicitly fostered through visual displays of learning partner knowledge (Bodemer & Dehler, 2011; Dehler et al., 2011). With such explicit support, learning through well-structured computer-supported collaboration has the potential to surpass face-to-face contexts (Buder, 2007; Dehler et al., 2011).

To date, however, investigations of the social effects of knowledge awareness on learning are scarce. In one investigation of these social effects, Ray and colleagues found that knowledge awareness enables learners to draw social comparisons (Ray, Neugebauer, Sassenberg, Buder, & Hesse, 2013). If learners know what knowledge their learning partner possesses, they can use him or her as a standard to evaluate their own abilities and attributes (Bandura & Jourden, 1991; Collins, 1996; Muller & Fayant, 2010; Festinger, 1954; Tesser & Cornell, 1991; Ray et al., 2013). In their investigation, Ray et al. (2013) focused on more knowledgeable learners' motivation to communicate knowledge to a less knowledgeable learning partner.

In this work, we develop the idea that knowledge awareness enables social comparison by focusing on less knowledgeable learners. Specifically, we investigate how knowledge awareness impacts less knowledgeable learners' motivation to make use of information provided by a more knowledgeable learner. We pursue this investigation in the context of peer help-seeking via computer supported knowledge exchange.

Social comparisons and knowledge awareness

Everyday social interactions provide us with opportunities to compare our accomplishments, lifestyles, or abilities with others. People's use of such comparisons in self-evaluation is extensive (Festinger, 1954). In learning settings, available comparisons differ from circumstance to circumstance. Often, a learner can select a wide variety of classmates for comparison (or avoid comparison all together) according to individual needs and momentary motivations. In cooperative learning, however, comparison options are constrained. For the duration of cooperation, learners can only compare themselves with their cooperation partner(s) or avoid comparison altogether.

When faced with a potential comparison, a learner may or may not utilize that comparison for self-evaluation. Whether a learner uses a particular comparison for self-evaluation is heavily influenced by that learner's disposition. There are stable individual differences in the tendency to engage in social comparisons for self-evaluation (Gibbons &

Buunk, 1999). Some people are more predisposed than others to rely on these comparisons. The impact of such individual differences is well documented in a variety of domains, such as satisfaction with social life, burnout among nurses and relationship satisfaction (Buunk et al., 2007; Buunk et al., 2010; Dijkstra et al., 2007).

In the context of learning in social settings, this means that learners who are predisposed to rely on social comparison for self-evaluation will be more affected by constrained comparison options than will learners who are not similarly predisposed. When comparison options are unconstrained (i.e., learners with a variety of achievement levels are available to compare with), learners who tend to rely on social comparison are free to seek comparisons that will serve their current goals most effectively. When comparison options are constrained, however (i.e., only superior or only inferior learners are available to compare with), learners predisposed to social comparison tend to utilize available comparisons even when such comparison might be counterproductive (Ray et al., 2013; Wheeler & Miyake, 1992; Wood, 1989).

The combination of learner predisposition to social comparison and constrained comparison targets has negative implications for the behavior of relatively knowledgeable learners during cooperation. Ray et al. (2013) staged a cooperative learning scenario in which participants had to study and explain a lesson on the human immune system to a less knowledgeable learning partner (actually fictitious). During this task, they manipulated knowledge awareness so that participants either became aware of their superior knowledge or did not become aware of knowledge differences. Ray et al. (2013) then observed the effects of social comparison motives and knowledge awareness on information sharing. The authors found that information sharing among learners who were predisposed to social comparison was governed by self-evaluation defense. Knowledgeable learners predisposed to social comparison reduced the amount of information they shared with their learning partner in order to preserve the flattering knowledge difference between them.

The picture that emerges from Ray et al. (2013) is thus alarming. Knowledge sharing is a crucial factor for effective peer-supported learning (O'Donnell & O'Kelly, 1994). Similarly, knowledge awareness is crucial to effective knowledge sharing (Dehler et al., 2011; Sangin et al., 2011). If the combination of knowledge awareness and social comparison undermines knowledge sharing by knowledgeable learners, then learner predisposition to social comparison appears to be a danger to successful peer-support during learning.

This conclusion would be overly simplistic, however. Comparison between one's own performance and a more knowledgeable learner can be good for learner motivation. In fact,

when comparison is unconstrained, students generally seek out comparison with better performing others, even at the cost of a less positive academic self-concept (Dijkstra et al., 2008). Such upward comparison usually evokes the need to reduce discrepancies between one's own and the better performing other's performance and is thus motivating (Buunk et al., 1990; Huguet et al., 2001; Lockwood & Kunda, 1997). Furthermore, people can choose to compare upward after experiencing failure in order find hope and inspiration as well as to learn how they can improve their performance (Ybema & Buunk, 1993). Seeing another succeed can increase one's motivation to improve because it provides a sense of one's own potential.

Such benefits to upward comparison suggest that the impact of constraining comparison on less knowledgeable learners might be very different from that observed by Ray et al. (2013) with more knowledgeable learners. For less knowledgeable learners, knowledge awareness presents an upward comparison; it suggests their knowledge is lacking. If utilized for self-evaluation, an upward comparison can present a threat to self-esteem or self-evaluation, but that threat is not necessarily detrimental (Buchs & Butera, 2009; Johnson, 2012; for an overview see Wheeler, 2000). Seeing one's own potential in the higher performance of others can actually turn the threatening comparison into a positive prospect for the self. Indeed, in educational contexts, such upward comparisons usually have positive outcomes; they motivate stronger engagement in the learning process (Dijkstra, et al., 2008). We thus expect that the combination of knowledge awareness and learner predisposition to social comparison will benefit learner engagement and learning outcomes among less knowledgeable learners in a knowledge exchange setting.

Diagnosticity as a moderator

Our main focus in this work was to understand the role of knowledge awareness and social comparison for less knowledgeable learners seeking peer input. As a subsidiary goal, we also explored a potential moderator of learners' use of knowledge awareness for social comparison, namely comparison diagnosticity.

People only rely on social comparisons for self-evaluation when they feel those comparisons are diagnostic, that is, when they can be certain that the self-knowledge gained from comparison is valid. (Festinger, 1954; Wheeler, 2000). In the case of diagnostic information, individuals feel enabled to estimate their own relative standing and act upon it. However, if the information available for comparison is non-diagnostic (i.e., unable to support definitive inference), individuals are not confident in the resulting estimation and will not

change their beliefs about themselves or their behaviors (Gilbert et al., 1995; Pemberton & Sedikides, 2001).

By default, the comparisons based on knowledge awareness are perceived as diagnostic because knowledge awareness is usually implemented based on learners' self-assessment of their own knowledge (Dehler Zufferey et al., 2011; Engelmann et al., 2009) and learners consider such self-assessments of knowledge to be valid (Boud, 2013; Ross, 2006). Indeed, in past work, learners showed no hesitation in relying on the comparisons present in knowledge awareness for social comparison (Ray et al., 2013). However, information that undermines the diagnosticity of the comparison present in knowledge awareness might have the potential to prevent predisposed learners from engaging in social comparison based on knowledge awareness because such learners would not gain valid information about themselves from the social comparison. In sum, if diagnosticity of information available for social comparison is perceived to be low, the resulting social comparison will not serve its aim, namely to provide information about one's own learning status. Therefore, low diagnosticity should undermine social comparison and associated behavioral responses to comparison outcomes.

We emphasize that exploring the role of diagnosticity is a subsidiary goal because undermining social comparison in the context of less knowledgeable learners is probably not desirable. In the context of less knowledgeable learners, we expect social comparison to motivate greater learner engagement. Gathering information about potential moderators is still useful, however, because it might provide insight in how to manage the harmful effects of social comparison among more knowledgeable learners observed in Ray et al. (2013).

Hypotheses and Overview

Primary Hypotheses

Consistent with previous research on knowledge awareness (Dehler et al., 2011; Engelmann et al., 2009; Sangin et al., 2011; Wittwer et al., 2010), we expected that:

Hypothesis 1: Learners who are aware of their partner's knowledge will better match their request for explanations to their learning partner's knowledge than learners who are not aware of their partner's knowledge.

Furthermore, based on the documented positive effects of upward comparison in both educational and non-educational settings (Dijkstra, et al., 2008; Johnson, 2012), we developed the following hypotheses:

Hypothesis 2: Knowledge awareness will increase less knowledgeable learners' engagement among learners who are predisposed to rely on social comparison for self-evaluation but not among learners who are not predisposed to social comparison.

Hypothesis 3: Knowledge awareness will improve less knowledgeable learners' performance on a knowledge test among learners who are predisposed to rely on social comparison for self-evaluation but not among learners who are not predisposed to rely on social comparison for self-evaluation.

Subsidiary Hypothesis

Based on the importance of diagnosticity of comparison outcome for the use of social comparison (Festinger, 1954; Wheeler, 2000) we predicted the following subsidiary qualification of our primary hypotheses:

Hypothesis 4: Knowledge awareness that is perceived to be non-diagnostic of ability will eliminate the positive effects of social comparison posited in hypotheses 2 and 3.

Overview

We tested our hypotheses in two experiments in which we staged a computer-based learning task and measured participants' predisposition to rely on social comparison for self-evaluation. In the learning task, participants studied a lesson on the human immune system and asked for further explanations from a fictitious learning partner. In both experiments, we manipulated knowledge awareness by providing participants with information about their learning partner's knowledge via a knowledge display. In this display, participants appeared less knowledgeable than their partner. We then observed the effects of participants' predisposition to social comparison and knowledge awareness on (a) the match between the explanations participants asked their partner for and their learning partner's lesson understanding, (b) participants' learning engagement, and (c) participants' learning outcomes. Experiment 1 also included a manipulation of information diagnosticity which indicated that knowledge awareness was diagnostic of probable later performance differences between the participant and their learning partner or that knowledge awareness was not diagnostic of such differences. Experiment 2 aimed to clarify interpretation of Experiment 1 by refining two aspects of the procedure from Experiment 1 and by focusing only on our primary hypotheses.

Study 3.1

Method

Participants and Design

One hundred twenty-seven students at a German university participated in a 2 (knowledge awareness: own knowledge only vs. own knowledge and partner knowledge) *x* 2 (diagnosticity: low diagnosticity vs. high diagnosticity) *x* Social Comparison Orientation (continuous) design in exchange for 8€. Participants' course of study varied between economics (35%), natural sciences (21%), law (20%), social sciences (9%), humanities (5%), and others (10%). Students who studied medicine, biology, and psychology were excluded from participating in order to limit participants' extensive prior knowledge about the learning material or our methods. Participants that frequently participated in past studies and were potentially familiar with the study material were excluded from analyses (our participant pool lacked the capability to screen ahead of time). Regression diagnostics indicated one case that was disproportionately influential (based on outlying values for Cook's D > .20). This case was subsequently excluded from analyses, reducing the final sample to 124 participants (79 women, 45 men, M_{age} = 20.05 years, range: 18 - 30).

Procedure

Participants arrived at the laboratory in groups of up to six people and were randomly assigned to one of the experimental conditions. They were told that they would have to answer a short personality questionnaire, study a lesson on the human immune system, ask for and learn with explanations a former participant (actually fictitious) wrote about the lesson elements, and take a knowledge test at the end of the experiment.

The study began with assessment of participants' Social Comparison Orientation (detailed in Measures section, 2.1.3). Next, participants studied a hypertext lesson on the human immune system adapted from Dehler Zufferey et al. (2011, see Appendix I for lesson content) (see also Ray et al., 2013). Pages were multilinked to allow flexible navigation. The lesson covered an overview of the human immune system, a chapter on non-specific immune responses, a chapter on humoral immune responses, and a chapter on cellular immune responses (944 words). The overview was divided into 4 sections, whereas the other three chapters were divided into 5 sections each, resulting in a total of 19 lesson sections. Participants had a 2 minute practice phase to read and learn the overview of the human immune system after which they were introduced to the knowledge awareness manipulation.

This practice phase served to familiarize participants with the learning material and the mechanics of the knowledge display.

The knowledge awareness manipulation was implemented with graphical knowledge displays that differed between conditions (Figure 1). This procedure closely followed the knowledge awareness manipulations applied in earlier research (e.g. Ray et al., 2013; Dehler Zufferey et al., 2011). These practice displays were constructed by asking participants to self-assess their knowledge by marking which of the four sections of the lesson overview they understood well enough to explain it to a learning partner. These answers were then displayed graphically. Small boxes next to each section indicated knowledge (green box) or knowledge deficits (red box). In the own knowledge only condition, participants viewed a display of only their own answers. In the own knowledge and partner knowledge condition, participants viewed a similar display but with their own as well as their partner's lesson understanding. This display provided knowledge awareness in a comparative format.

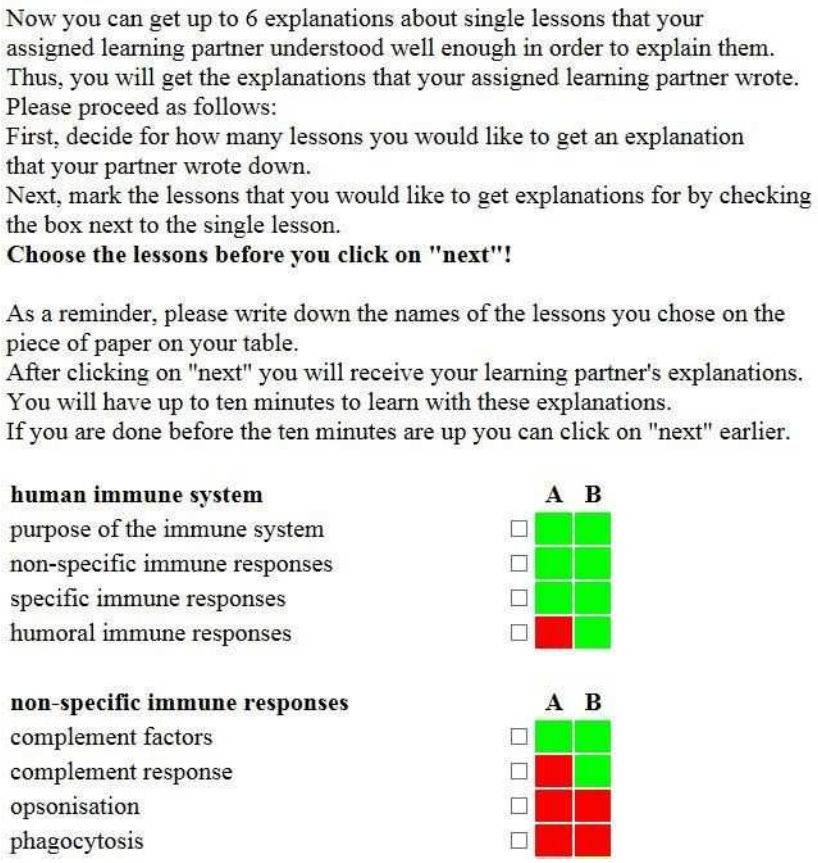

Figure 5: Segment of an exemplary knowledge awareness manipulation in own and partner knowledge condition, Study 3.1. Participants initially saw the list of topics (pictured in the lower left) and indicated whether they understood each topic well enough to explain it to a learning partner. Participants' responses were then displayed in column 'A' with areas they understood indicated by a green square and areas they did not understand indicated by a red square. When knowledge awareness was present, participants saw their more knowledgeable partner's understanding in column 'B'. Participants requested explanations by checking one of the boxes next to column 'A'. In the example pictured, the participant did not

understand four of the visible topics whereas their learning partner did not understand two of the visible topics. The participant has not yet requested any topics for explanation.

After the practice phase, participants studied the three chapters on the specifics of the human immune system for fifteen minutes. Participants had pen and paper available in case they wanted to take notes while learning. Next, participants indicated which of the remaining 15 lesson sections they understood well enough to explain to a learning partner. Participants then saw the main knowledge awareness manipulation encompassing all 19 lesson sections. Depending on the experimental condition, participants either saw a display of their own lesson understanding organized by lesson chapter and section or saw a comparable display of their own as well as their partner's lesson understanding. The partner's understanding ($M = 15.94$, $SD = 3.45$ green boxes) was constructed by randomly adding five understood lessons to the participant's indicated understanding ($M = 10.67$, $SD = 4.21$ green boxes). Thus, the learning partner always appeared more knowledgeable than the participant. In the own knowledge only condition, participants did not receive any information regarding their partner's understanding.

Directly after the knowledge awareness manipulation, participants encountered the diagnosticity manipulation.[7] The diagnosticity of the social comparison present in the knowledge display (i.e., its usefulness for assessing one's own relative knowledge level) was manipulated by showing participants a graphical comparison of their learning potential compared to their learning partner's final test performance (Figure 2). In the own knowledge only condition, the graph did not include their partner's test performance. Participants' depicted potential test performance either covered a wide range of potential final test performance, indicating low information diagnosticity, or covered a narrow range of potential final test performance, indicating high information diagnosticity.

[7] To test whether this manipulation affected perceived diagnosticity in the intended way, we ran a pilot study with a separate sample from the same population. Participants received the diagram and the instructions either from the knowledge awareness/high diagnosticity or from the knowledge awareness/low diagnosticity condition framed as a scenario. In this scenario, participants were asked to imagine that they were the lower performing person (i.e., the role participants had in the study). Participants were asked "Based on the figure, how exactly can your (partner 2's) performance after learning with partner 1 be predicted at this point?" (exact translation from German). They responded on a 7 point scale ranging from 0 for not at all to 6 for absolutely. In line with the intended effect of the manipulation, participants in the high diagnosticity conditions felt they were better able to predict their own performance, and thus perceived higher diagnosticity in the upward comparison of probable performance, (M ¼ 3.21, SD ¼ 1.25) than participants in the low diagnosticity condition (M ¼ 2.07, SD ¼ 1.54), t (25) ¼ 2.28, p ¼ .032, d ¼ .91. These results confirm the general efficacy of the diagnosticity manipulation. Note, however, that these results do not provide information about the specific reactions of the participants in the main study. More precise measurement could be accomplished in future designs by incorporating a manipulation check directly into the main study.

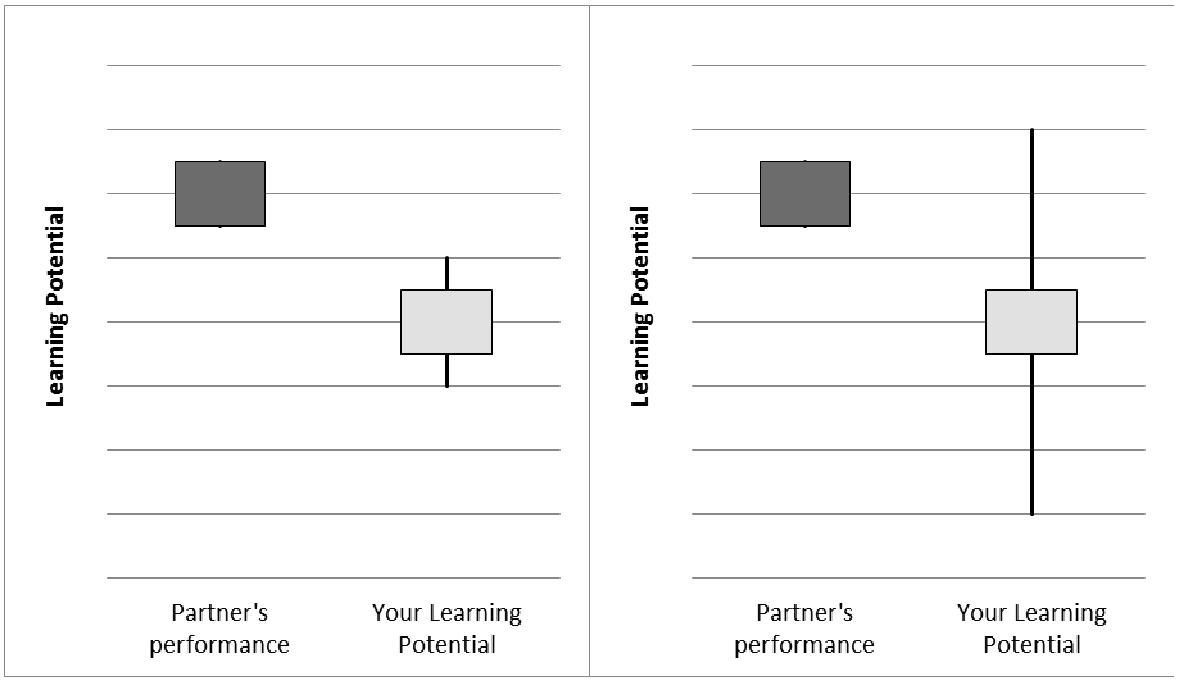

Figure 6: Manipulation of high and low diagnosticity in own and partner knowledge conditions, Study 3.1. The manipulation consisted of a graphical display of participant's learning potential compared to their learning partner's final test outcome. Participant's depicted potential test performance either covered a wide range of potential final test performance, indicating low information diagnosticity, or covered a narrow range of potential final test performance, indicating high information diagnosticity. In own knowledge only conditions, participants did not see their partner's performance. The display was accompanied by the text, *"Your previous performance can be used to estimate your future learning potential. The following graph shows how much you can improve your performance by additional learning. Your previous performance is represented by the grey box. The lines above and under this box indicate how much your performance can change with additional learning."*

After these manipulations, participants could choose up to six explanations about lesson sections from a former participant (see Figure 1). If participants checked zero lesson sections they were asked to confirm their response before moving on to the second learning phase. In practice, participants almost always selected the maximum possible number of explanations.[2] Participants then received the explanations they asked for and started the second learning phase. In order to strengthen participant's perception about the reality of their learning partner we included a participant number and the date of participation of their fictitious learning partner. Participants had up to ten minutes to learn with this material. Note that we did not provide explanations for areas which were indicated to be outside of learning partner knowledge.

Next, participants completed the measure of learning engagement (i.e., self-set goals) and took a knowledge test assessing participants' learning outcomes on their own pace. The experiment then ended with demographic items, probing for suspicion about the experimental deceptions, and a debriefing.

Measures

We assessed Social Comparison Orientation, the match between chosen explanations and learning partner knowledge, learning engagement, and learning outcomes.

Social Comparison Orientation. Social Comparison Orientation was measured with a validated German translation of Gibbons and Buunk's (1999) Iowa-Netherlands Comparison Orientation Measure (Jonas & Huguet, 2008, see Appendix II for items). Each of the 7-point scales accompanying the items, for example, "I often compare myself with others with respect to what I have accomplished in life" was anchored by -3 (*I do not agree at all*) to +3 (*I fully agree*). Reliability of the scale was acceptable at Cronbach's $\alpha = .78$ ($M = 1.16$, $SD = 0.77$, range = -1.82 to 3).

Explanation match. The match between the explanations participants requested and their learning partner's knowledge was measured with the percent match between the areas that participants wished to receive explanations for from the partner and the areas that the learning partner did understand. That is, explanation match assessed how often participants asked for information that their learning partner was able to provide. Higher numbers indicate better explanation request match. In the own knowledge only condition, partner knowledge was generated as in the other condition but not displayed.

Learning engagement. Participants' engagement was measured by the number of their self-set goals. The number of goals is, according to Goal Systems Theory (Kruglanski et al., 2002) and supporting findings, an antecedent of engagement. If multiple goals can be achieved with the same action (i.e., studying the explanations from the learning partner) engagement in that activity becomes stronger (Fehr, Sassenberg, & Jonas, 2012; Kopetz, Hofmann, & Wiers, 2014; Shah & Kruglanski, 2002).The number of goals that participants had active during the learning phase thus provides an indirect index of participants' engagement with the learning phase. Participants were asked to list the goals they had while they were learning the human immune lesson ("*Which goals did you set yourself while you were learning? Please, name one at a time."*). Participants could name up to five goals.

Learning outcome. A test on the lesson material assessed participants' learning outcomes at the end of the experiment. We adapted this test from Dehler Zufferey et al. (2011, see Appendix III for items) by adding an "I don't know" option to reduce guessing. The test consisted of 15 multiple choice items with four main options, one "none of the above" option, and finally the added "I don't know" option. Multiple correct responses were possible for each

item resulting in a total score out of 27 correct answers. Reliability of the test was acceptable at Cronbach's α = .69.

Results

Explanation match

Consistent with previous work on knowledge awareness, we expected that participants who were aware of their partner's knowledge would better match their requested explanations to their learning partner's lesson understanding. We expected only an effect of knowledge awareness (Hypothesis 1). To test this prediction, we performed a multiple regression analysis on the percentage match between requested explanations and partner knowledge (M = 83.02%, SD = 24.64, range = 0% to 100%) with diagnosticity (coded low diagnosticity = -1 and high diagnosticity = +1), knowledge awareness (coded own knowledge only = -1 and own knowledge and partner knowledge = +1), and mean-centered social comparison orientation as predictors. As expected, the analysis yielded only a main effect of knowledge awareness, b= .09, SE = .02, p < .001. Participants who were aware of their partner's knowledge better matched their requests for explanation to their partner's knowledge (M = 91.72%, SD = 17.97) than did participants who were not aware of their partner's knowledge (M = 74.87%, SD = 27.25). Explanation match did not differ significantly between diagnosticity conditions, b = .01, SE = .02, p = .801, nor levels of social comparison orientation, b = .02, SE = .03, p = .511 (all other $|b|$s < .03, all ps > .260). In support of Hypothesis 1, this finding replicates the positive effect of knowledge awareness in that it facilitates matching a less knowledgeable learner's explanation requests to the knowledge of a more knowledgeable learner.

Learning engagement

We predicted that awareness of a learning partner's superior knowledge would increase learner engagement among participants high in social comparison orientation but not among participants low in social comparison orientation (Hypothesis 2). Furthermore, we expected the positive influence of knowledge awareness to disappear if participants received information indicating that the comparison present in knowledge awareness was not diagnostic about their future relative standing (Hypothesis 4). Number of self-set goals is graphed by social comparison orientation, knowledge awareness, and diagnosticity in Figure 3.

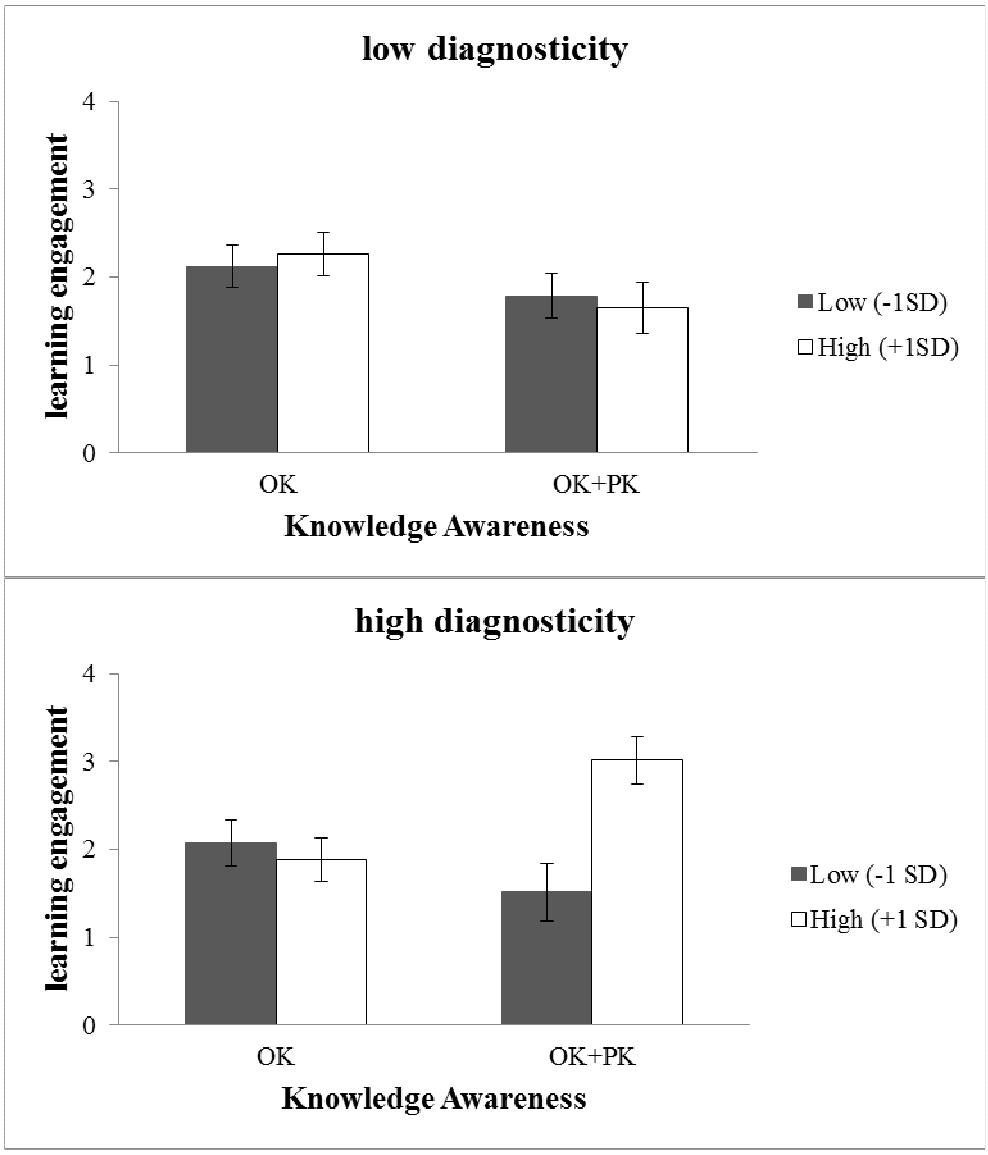

Figure 7. Number of self-set goals after Own Knowledge (OK) and Own and Partner Knowledge (OK+PK) by Social Comparison Orientation and high and low Diagnosticity, Experiment 1. Error bars represent cell standard errors. Knowledge awareness led to increased goal setting for people high in social comparison orientation, but only in the high diagnosticity conditions.

We tested these predictions with multiple regression analysis predicting the number of self-set goals (M = 2.07, SD = 1.07, range = 0 to 5) from social comparison orientation, knowledge awareness, and the diagnosticity manipulation. As expected, the multiple regression analysis yielded a significant three-way interaction of knowledge awareness, social comparison orientation, and diagnosticity, b = .31, SE = .13, p = .013. Table 1 summarizes the full regression analysis.

Table 1. Summary of the multiple regression on learning engagement with diagnosticity, knowledge awareness, and social comparison orientation as predictors, Study 1. All lower order effects are qualified by the predicted three-way interaction.

Model	*B*	*SE B*	*p*
Social comparison orientation	.21	.13	.097
Knowledge awareness	.04	.09	.643
Diagnosticity	-.09	.09	.358
Diagnosticity x Knowledge awareness	.20	.09	.037
Social comparison orientation x Knowledge awareness	.23	.13	.074
Social comparison orientation x Diagnosticity	.21	.13	.095
Social comparison orientation x Knowledge awareness x Diagnosticity	.31	.13	.013

In order to probe the nature of this interaction, we decomposed it into two two-way interactions at low and high levels of diagnosticity. As expected, social comparison orientation and knowledge awareness interacted significantly if diagnosticity was high, $b = .54$, $SE = .19$, $p = .005$, but did not interact if diagnosticity was low, $b = -.09$, $SE = .16$, $p = .591$. We examined the influence of knowledge awareness at high diagnosticity among people relatively high and relatively low in social comparison orientation using simple slopes analyses. This analysis shifts social comparison orientation one standard deviation above and below its mean and examines each possible pairwise comparison between the levels of social comparison orientation at different levels of knowledge awareness (Cohen et al., 2003). Note that this procedure is fully analogous to probing an interaction with simple comparisons in an ANOVA framework.

If diagnosticity was high and participants were aware of their partner's knowledge, participants who were high in social comparison orientation set themselves more goals ($M = 3.01$) than did participants who were low in social comparison orientation ($M = 1.52$), $b = .96$, $SE = .30$, $p = .002$. Participants who were not aware of their partner's knowledge did not show such differences in self-set goals. Among those participants, the number of self-set

goals did not differ significantly between people high ($M = 1.88$) and low in social comparison orientation ($M = 2.01$), $b = -.12$, $SE = .23$, $p = .604$.

In support of Hypothesis 2, these results indicate that people who are predisposed to rely on social comparisons for self-evaluation set themselves more goals if they are made aware of their partner's superior knowledge. In support of Hypothesis 4, this relation disappeared when participants were given information that the comparison was not diagnostic of future performance differences between them and their learning partner.

Learning outcome

We predicted that knowledge awareness would improve test performance among participants high in social comparison orientation but not among participants low in social comparison orientation (Hypothesis 3). However, we expected these positive effects of knowledge awareness to disappear if participants received information indicating that the comparison present in knowledge awareness was not diagnostic of their relative standing (Hypothesis 4). We computed a multiple regression analysis predicting knowledge test performance ($M = 12.06$, $SD = 4.13$, range = 3 to 20) from social comparison orientation, knowledge awareness, and diagnosticity. Unexpectedly, the analysis yielded neither a significant three-way interaction of diagnosticity, knowledge awareness, and social comparison orientation, $b = -.22$, $SE = .51$, $p = .666$, nor other interactions or main effects, all $|b|$s $< .74$, all ps $< .148$. We thus failed to obtain support for Hypothesis 3 and were unable to evaluate Hypothesis 4 in the context of learning outcomes.

Interestingly, learning engagement was not correlated with learning outcomes or explanation match (both $|r| < .14$, both ps $> .10$).

Discussion

Experiment 1 provided initial evidence for three of our four hypotheses. Knowledge awareness not only led to better matching of a less knowledgeable collaborator's requests for explanations to their learning partner's understanding (Hypothesis 1), but also to more learning engagement if participants were predisposed to rely on social comparisons for self-evaluation (Hypothesis 2). Furthermore, the relation between participants' predisposition towards social comparison, knowledge awareness, and learning engagement disappeared when knowledge awareness appeared to be non-diagnostic of future performance differences between participants and their learning partners (Hypothesis 4).

Surprisingly, we did not observe evidence that the combination of social comparison and knowledge awareness led to better test performance (Hypothesis 3). This is somewhat odd given the evidence of more learner engagement and the documented beneficial effects of upward comparison in educational contexts (Dijkstra, et al., 2008). This outcome could be unrepresentative, a result of flaws in our procedure – the measure of learning engagement we used was indirect - or evidence that participants' self-reported engagement was either illusory or ineffective.

We carefully examined our procedures and the associated pretesting and found no basis on which they might artificially undermine test performance. We were thus most concerned with evaluating the possibilities that (a) the discrepancy between self-reported learning outcomes and learning engagement might be unrepresentative or (b) the discrepancy might reflect illusory or ineffective learner engagement.

Study 3.2

Assessing the reliability of our initial findings presented a straightforward problem. A close replication focused on our core hypotheses would allow us to assess the consistency of our core results. In such a replication, we felt it was more appropriate to focus on only our core results at the expense of further exploration of diagnosticity for two reasons. First, the knowledge awareness manipulations we implemented are viewed as diagnostic by default (Boud, 2013; Ray et al., 2013; Ross, 2006). Manipulating diagnosticity in Experiment 1 served to undermine comparison processes previously documented in other contexts. Second, Experiment 1's subsidiary goal of undermining social comparison through diagnosticity might actually have been more germane to the study of more knowledgeable learners making downward social comparisons than to the present investigation. Although, diagnosticity presents an important variable in social comparison, both our theoretical framework and the results of Experiment 1 suggest that undermining social comparison through diagnosticity is counter-productive when focusing on less knowledgeable learners making upward social comparisons (as we do here). We thus decided to replicate our first experiment without the manipulation of information diagnosticity.

Additionally, in order to more effectively understand learner engagement we changed our measurement of the construct. Measuring engagement with the number of self-set goals introduced two possible ambiguities. First, the number of self-set goals did not account for the importance of a single goal. Indeed, a single important goal can be more meaningful than several unimportant objectives. Second, setting goals is about future intentions. It is quite

possible for future intentions to fail to translate into actual behavior (Gollwitzer & Sheeran, 2006; Webb & Sheeran, 2006). We therefore used a more direct and explicit measure of learner engagement in our second experiment; we assessed self-rated effort after learning from the explanations provided by participants' learning partners.

We also made one additional change intended to bolster the validity of our knowledge awareness manipulation. The knowledge display in Experiment 1 presented participant and partner knowledge next to one another in the knowledge awareness condition. It is possible that this visual contiguity might have prompted comparison which otherwise might not have occurred. Thus, the effect we found might be limited to this specific display. We therefore changed the knowledge display in the knowledge awareness condition so that it only showed participant's learning partner's knowledge in Experiment 2. Such a display still allows for social comparison because, in our procedure, participants provide the same information present in the display just before they receive the information about the partner knowledge. However, social comparison could not be directly triggered by the spatial proximity created by presenting responses about own knowledge next to information about partner knowledge.

In summary, Experiment 2 closely replicated Experiment 1 with the following exceptions: (a) we did not employ a manipulation of comparison diagnosticity, (b) we measured learner engagement with self-rated effort instead of self-set goals, and (c) the knowledge display in the knowledge awareness condition showed only learning partner knowledge instead of both participant and learning partner knowledge.

Method

Participants and Design

One hundred and four students at a German university participated in a 2 (knowledge awareness: own knowledge only or partner knowledge only) *x* Social Comparison Orientation (continuous) design in exchange for 8€. Participants' course of study varied between natural sciences (26%), humanities (21%), social sciences (15%), economics (11%), law (11%), and others (16%). Students who studied medicine, biology, and psychology were excluded from participating in order to limit participants' extensive prior knowledge about the learning material or our methods. Participants that frequently participated in past studies and were potentially familiar with the study material were excluded from analyses. Regression diagnostics indicated one case that was disproportionately influential (based on outlying values for Cook's D > .20). This case was subsequently excluded from analyses, reducing the final sample to 89 participants (62 women, 27 men, M_{age} = 22.37 years, range: 17 - 33).

Procedure

The procedure paralleled Experiment 1 with the following alterations. First, we presented only learning partner knowledge when creating knowledge awareness. Second, we removed the diagnosticity manipulation eliminating any suggestion that the knowledge difference presented in knowledge awareness might not be diagnostic of future performance. Third, we measured participants' self-rated effort after the second learning phase as a measure of learning engagement.

Measures

We assessed Social Comparison Orientation, the match between selected explanations and learning partner's knowledge, participants' self-rated effort, and participants' learning outcomes.

Explanation match, learning outcome, and Social Comparison Orientation. The assessment of explanation match, learning outcome, and Social Comparison Orientation was parallel to Experiment 1. Reliability of the scale for Social Comparison Orientation was again acceptable and comparable to that of Experiment 1, Cronbach's α = .79 (*M* = 1.18, *SD* = 0.77, range = -1.64 to 2.73). Reliability of the knowledge test was again also acceptable at Cronbach's α = .79.

Learning engagement. Self-rated effort, as a measure of learning engagement, was assessed with a single item on a seven point scale from 0 (*no effort*) to 6 (*as much effort as possible*).

Results

Explanation match

Consistent with previous work, we expected participants to better match their requests for explanations to their partner's knowledge if they were aware of their partner's knowledge than if they were not aware of their partner's knowledge (Hypothesis 1). We performed a multiple regression analysis on the percentage match between requested explanations and partner knowledge (*M* = 84.87%, *SD* = 27.18, range = 0% to 100%) with knowledge awareness (coded own knowledge only = -1 and partner knowledge only = +1), and centered social comparison orientation as predictors. As in Experiment 1, the analysis only yielded a main effect of knowledge awareness, $b = .11$, $SE = .03$, $p < .001$ (all other $|b|$s < .54, all ps < .106). As expected, participants who were aware of their partner's knowledge better matched

their requested explanations to their partner's knowledge (M = 94.56%, SD = 20.52) than did participants who were not aware of their partner's knowledge (M = 73.66%, SD = 29.69). In support of Hypothesis 1, this result indicates that knowledge awareness effectively guided participants in seeking information.

Learning engagement

We predicted that awareness of a learning partner's superior knowledge would lead to more learning engagement (i.e., higher self-rated effort) among participants who were high in social comparison orientation but not among participants who were low in social comparison orientation (Hypothesis 2). In order to assess this hypothesis, we ran multiple regression analysis predicting learning engagement (M = 4.37, SD = 1.13, range = 1 to 6) from knowledge awareness (coded own knowledge only = -1 and partner knowledge only = +1) and mean-centered social comparison orientation. As in Experiment 1, this analysis yielded the predicted interaction of knowledge awareness and social comparison orientation on self-rated effort, b = .40, SE = .15, p = .009. Furthermore, simple slopes analyses (shifting social comparison orientation one standard deviation above and below its mean) revealed that people who were aware of their partner's knowledge and who were high in social comparison orientation reported more effort (M = 4.68) than did people who were aware of their partner's knowledge and low in social comparison orientation (M = 3.72), b = .60, SE = 22, p = .007. However, the difference in self-rated effort between participants high (M = 4.37) and low (M = 4.70) in social comparison orientation was not significant if participants were not aware of their partner's knowledge, b = -.21, SE = .21, p = .317. Learning engagement is graphed by levels of knowledge awareness as well as levels of social comparison orientation in Figure 4, panel A. Consistent with Experiment 1 and Hypothesis 2, these results indicate that people who are predisposed to rely on social comparisons for self-evaluation engage more if they are made aware of their learning partner's superior knowledge.

Learning outcomes

We predicted that awareness of a learning partner's superior knowledge would also lead to better test performance among participants high in social comparison orientation but not among participants low in social comparison orientation (Hypothesis 3). However, in Experiment 1, we did not observe this relationship. In order to reassess the impact of knowledge awareness and social comparison orientation on learning outcomes (M = 11.24, SD = 4.88, range = 2 to 24), we ran multiple regression analysis with knowledge awareness

(coded own knowledge only = -1 and partner knowledge only = +1) and centered social comparison orientation as predictors for participants' scores on the knowledge test.

In contrast with Experiment 1, the multiple regression analysis yielded the predicted interaction of knowledge awareness and social comparison orientation on learning outcomes, $b = 1.63$, $SE = .65$, $p = .015$. Furthermore, simple slopes analyses revealed that people who were aware of their partner's knowledge scored higher on the knowledge test if they were also high in social comparison orientation ($M = 13.60$) than if they were also low in social comparison orientation ($M = 9.27$), $b = 2.71$, $SE = .95$, $p = .005$. However, among participants not aware of their learning partner's knowledge, the difference in learning outcomes between participants high ($M = 10.42$) and low ($M = 11.28$) in social comparison orientation was not significant, $b = -.54$, $SE = .89$, $p = .548$. Learning outcomes are graphed by knowledge awareness and social comparison orientation in Figure 4, panel B. In support of Hypothesis 3, these results indicate that people who are predisposed to rely on social comparisons for self-evaluation attain better learning outcomes if they are made aware of their learning partner's superior knowledge.

Oddly, given the parallel patterns between learning engagement and learning outcomes in this study, learning engagement was again not significantly correlated with learning outcomes and also not with explanation match, (both $|r| < .13$, both ps $> .25$).

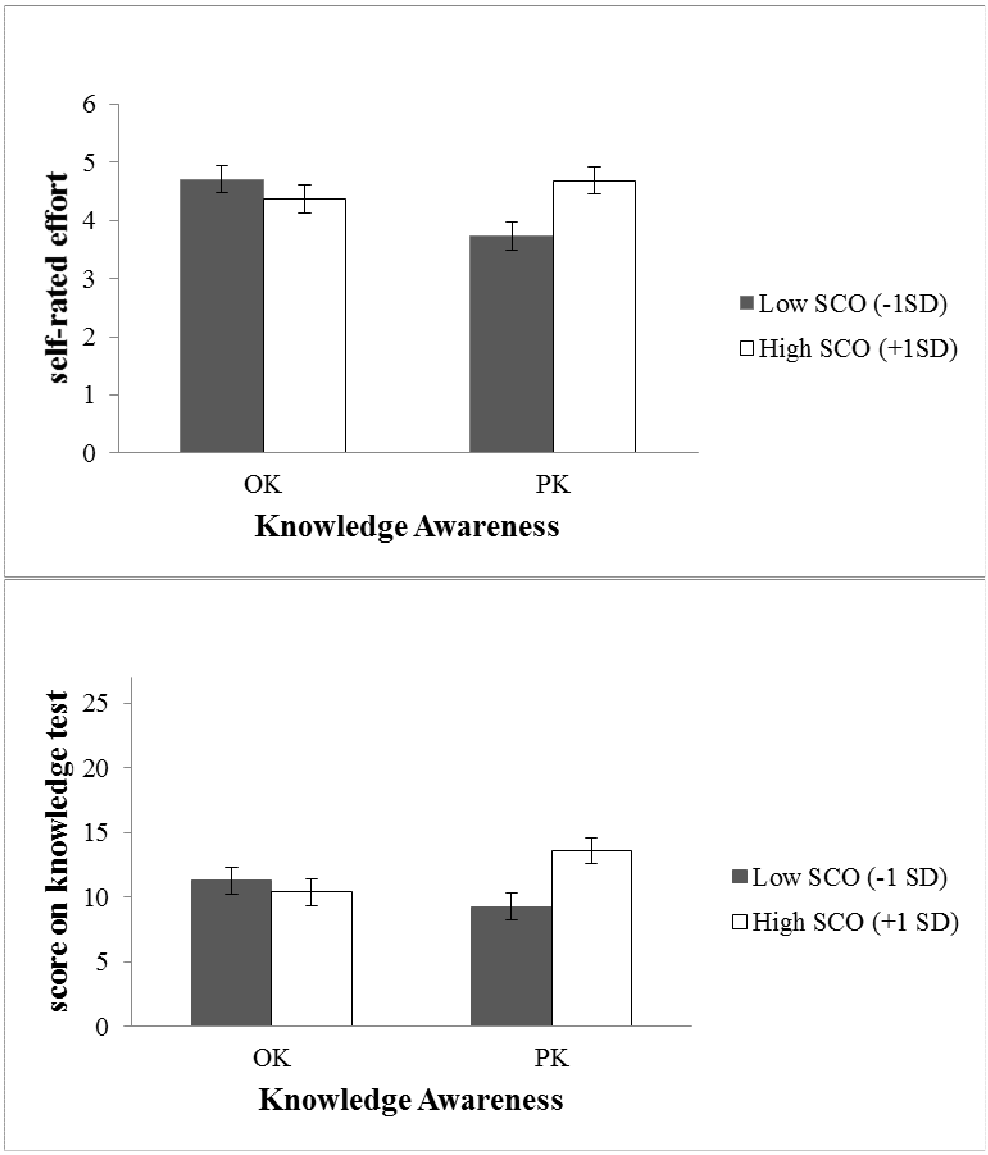

Figure 8. Learning engagement (panel A) and learning outcome (panel B) after Own Knowledge (OK) and Partner Knowledge (PK) awareness by low and high levels of Social Comparison Orientation, Experiment 2. Error bars represent cell standard errors. Knowledge awareness led to increased self-reported effort and increased test performance among participants high in social comparison orientation but not among participants low in social comparison orientation.

Discussion

Experiment 2 provides important new information to supplement that present in Experiment 1. Across both experiments, the effect of knowledge awareness and social comparison on learner engagement is clear; awareness of a learning partner's superior knowledge prompted learners who are predisposed to social comparison to engage more strongly in learning. This was true when engagement was measured indirectly with self-set goals (Experiment 1) or with face valid ratings of effort (Experiment 2). Additionally, Experiment 2 provides evidence linking learner engagement to better learning outcomes, a result missing from Experiment 1.

General Discussion of Chapter 3

We made three primary predictions about the benefits for less knowledgeable learners of knowledge awareness and social comparison during knowledge exchange. Hypothesis 1 stated that, consistent with past findings (Dehler Zufferey et al., 2011; Sangin et al., 2011), knowledge awareness would allow less knowledgeable learners to better match their requests for information to more knowledgeable learners expertise. This hypothesis was supported in both experiments. Hypothesis 2 stated that knowledge awareness would increase learner engagement among less knowledgeable learners predisposed to social comparison but not among less knowledgeable learners not predisposed to social comparison. The hypothesis was also supported in both experiments. Hypothesis 3 stated that knowledge awareness would improve learning outcomes among less knowledgeable learners predisposed to social comparison but not among less knowledgeable learners not predisposed to social comparison. This hypothesis was supported in Experiment 2 but not in Experiment 1. Overall these results provide strong evidence that the combination of social comparison and knowledge awareness is beneficial for less knowledgeable learners.

This finding provides an important complement to existing knowledge about the interplay between knowledge awareness and social comparison in knowledge exchange. The social comparison present in knowledge awareness undermines knowledge exchange when employed for self-evaluation by more knowledgeable learners (Ray et al., 2013). Based on Ray et al. (2013) alone, it might be tempting to conclude that social comparison should always be avoided during knowledge exchange so that learners can gain the maximal benefits of knowledge awareness. The results reported here indicate that the role of social comparison in knowledge exchange is more nuanced. Although it is harmful for more knowledgeable learners to draw on the social comparison present in knowledge awareness, less knowledgeable learners actually benefit from the comparison.

These findings have clear practical implications for educational settings. Social comparison during knowledge exchange between learners can be either an asset or a liability depending on the role that a particular learner occupies. For less knowledgeable learners seeking help, social comparison has the potential to encourage engagement with peer input. For more knowledgeable learners providing feedback and knowledge, social comparison has the potential to undermine the communication of knowledge to peers. Cooperative learning might thus be most effective when social comparison is selectively encouraged among less knowledgeable learners and selectively discouraged among more knowledgeable learners. Naturally, any such intervention would need to carefully balance the motivational benefits of

encouraging social comparison among less knowledgeable learners and the implications for academic self-esteem (Dijkstra et al., 2008).

Additionally, Experiment 1 provides subsidiary insight into how social comparison based on knowledge awareness might be discouraged. When the diagnosticity of knowledge awareness for future performance was undermined, even participants predisposed to social comparison did not utilize the comparison present in knowledge awareness (Hypothesis 4). Although this effect is not desirable among less knowledgeable learners, it does provide preliminary evidence about a possible avenue by which social comparison among more knowledgeable learners might be managed.

We have focused on the impact of social comparison and knowledge awareness on learner engagement because of the presumed benefits of motivation for learning. In fact, the relationship between motivation and learning is not necessarily so straight forward. A motivated learner must be able to translate their desire to learn or perform into effective action (e.g., Bell & Kozlowski, 2002; Stalbovs, Scheiter, & Gerjets, 2015). In this work, we observed a relationship between social comparison and knowledge awareness with learner engagement more reliably (Experiments 1 and 2) than with learning outcomes (Experiment 2 only). We suspect this reflects the challenge of translating increased motivation into actual knowledge gains. Indeed, the apparent lack of correlation between learner engagement and learning outcomes observed in both experiments is consistent with this idea. Attempts to harness social comparison in the service of learning might be most effective when paired with instrumental support for effective learning.

One might ask how we can be confident that social comparison is what truly drives the effects observed here. After all, we measured participants' predisposition to social comparison rather than measuring social comparison directly. Indeed, to the extent that social comparison orientation is confounded with other personality traits, those other personality traits could be driving our observed results. There are several reasons to be skeptical of this criticism, however. In Experiment 1, the relationship between participants' predisposition to social comparison, knowledge awareness, and effort was moderated by a factor theoretically related to social comparison - information diagnosticity. Plausible confounds would thus need to respond to both knowledge awareness and information diagnosticity in the same way as social comparison orientation. Such confounds are difficult to generate parsimoniously. More directly, our measure of participants' predisposition to social comparison (social comparison orientation) has been well validated in previous work (Buunk, et al., 2007, 2010; Dijkstra, et al., 2007; Gibbons & Buunk, 1999). In fact, past work also demonstrates convergence

between the effects of measured predisposition to social comparison and situationally induced social comparison in cooperative learning settings (Ray et al., 2013). This validational work provides additional assurance that effects arising from social comparison orientation actually do reflect social comparison processes rather than an undefined confounding factor.

At first glance, our results might appear to be at odds with other work examining social comparison in the context of learning. Buchs and Butera (2009) found that cooperating with an extremely competent learning partner can harm learning outcomes. Critically, this work examined a task in which a learning partner set a high standard of performance on a task that participants had to immediately perform following their learning partner. In other words, a high quality performance from a learning partner induced evaluation apprehension about participant's own upcoming performance. In contrast, in the research reported here, participants were not evaluated on any contributions to cooperation. Instead participants' performance was evaluated with an individual knowledge test following cooperative learning.

The contrast between these findings raises the intriguing possibility that the impact of upward social comparisons during knowledge exchange might depend on whether learners expect to have their contribution to the cooperation evaluated or not. If learners expect to have their contributions evaluated, upward social comparison might lead to disengagement or distraction. If learners do not expect to have their contribution evaluated, however, then learners might be free to seize on upward social comparisons for instruction and inspiration.

The work reported here focused closely on a subset of variables (motivation, knowledge awareness, and learner predisposition to social comparison) that are relevant to a wide variety of educational settings. Our particular choice of experimental context, computer supported knowledge exchange between peers, was selected because it allowed us to cleanly manipulate knowledge awareness independently of learner predisposition to social comparison. One consequence of this decision is that our results speak most directly to the context of computer supported knowledge exchange between peers. This context is increasingly important as education becomes increasingly digitized and student interactions move online (New Media Consortium, 2014). However, the basic processes under study here also occur in more dynamic forms of knowledge exchange between peers and in face-to-face exchanges of knowledge. In fact, our theoretical treatment of knowledge awareness originally derives from the literature on face-to-face collaborative learning. Our results thus have theoretical implications for the field of collaborative learning, broadly construed.

The current research clearly speaks to the field of computer-supported collaborative learning (CSCL). The concept of knowledge awareness and tools for implementing it are very

popular in this field. The combination of our current research and earlier research (Ray et al., 2013) clearly indicates that learners' predisposition to social comparison can both harm and help knowledge exchange, depending on whether peers are acting as a less knowledgeable learner or as a more knowledgeable explainer. It might thus be wise to monitor learners' predispositions to social comparison when implementing knowledge awareness tools. In fact, one might even consider designing settings that selectively encourage or discourage social comparison together with knowledge awareness tools. More generally, this work calls for considering the interplay of the cognitive and social design across learning settings.

These experiments focused on an element of learning, peer-to-peer knowledge exchange that is vital to both face-to-face and computer-supported collaborative learning. We suggest that these findings are thus applicable to collaborative learning. One might reasonable ask, however, if our finding would hold in the richer social environment entailed by collaboration. Certainly, the social comparison literature on which we base our framework applies in such settings. The social comparison processes we draw on have been demonstrated in settings ranging from classrooms (Dijkstra et al., 2008) to interpersonal sabotage between friends (Tesser & Smith, 1980). We therefore find it reasonable to suggest that our findings would generalize to the rich social contexts of cooperative and collaborative learning. This expectation can only be confirmed through empirical investigation, however.

Learner social comparison motives appear to be an important determinant of the effectiveness of help-seeking and cooperative learning. The available evidence suggests that social comparison motives greatly influence how learners response to knowledge awareness. Social comparison hinders effective cooperation among more knowledgeable learners (Ray et al., 2013) but motivates greater engagement with knowledge exchange and help seeking among less knowledgeable learners. Finding effective ways to manage social comparison during knowledge exchange and cooperative learning by encouraging it in some but discouraging it in others thus has the potential to enhance the efficacy of collaborative learning.

Chapter 4: Learners' habitual social comparisons can hinder effective learning partner choice[8]

Collaborative learning is widely employed at all levels of education (Johnson et al., 2007). Learning partners are sometimes student selected and sometimes assigned by an instructor. Allowing students to choose their own learning partner can be useful for several reasons. First, having a choice, and thus a sense of control over a situation, motivates students to engage with learning (for an overview see Pintrich, 2003). Also, having a choice is generally a strong intrinsic motivator for learners to put effort into a task (Patall, Cooper, & Robinson, 2008; Lewin, 1999). Overall, higher levels of perceived control help students to achieve higher levels of performance and students who feel in control of their learning are more likely to do well than students who do not feel in control of their learning (Pintrich, 2003).

When given a choice in learning partner, it would seem most effective for students to seek the most capable learning partner available; more capable learning partners have more information to share. At the same time, people might be intimidated by a more capable partner or might prefer another partner for social reasons. This raises the question of how learners deal with competing motives when choosing a learning partner. The current research sought to provide an answer to this question by studying the impact of (a) learner's habitual tendency to compare with others and (b) strategic comparison motivations that might influence learning partner choice.

While learning collaboratively, students are constantly confronted with others who provide comparison information on metrics such as grades, cognitive performance, and physical performance (Dijkstra et al., 2008; Levine, 1983; Pepitone, 1972). Evaluating one's self through comparison with others (i.e., social comparison) is normal, healthy, and universal (Festinger, 1954).

At the same time, there are stable individual differences in people's tendency to make use of comparison information (Gibbons & Buunk, 1999). Such individual differences have well-documented impacts in a variety of domains, such as satisfaction with social life, burnout among nurses, and relationship satisfaction (Buunk et al., 2007; Buunk et al., 2010; Dijkstra et al., 2007). Moreover, learner predisposition to social comparison influences information sharing during collaborative learning. Learners who are predisposed to comparison make

[8] This chapter has been submitted for publication.

better use of information provided by more knowledgeable learning partner (Neugebauer, Ray, & Sassenberg, 2016) but share less information with less knowledgeable learning partners (Ray et al., 2013).

For those predisposed to social comparison, drawing comparisons might be best viewed as a habit. Comparisons are often drawn without intention (Langer, Pirson, & Delizonna, 2010) and some people routinely rely on comparison information (Jonas & Huguet, 2008). In fact, Gilbert and colleagues (1995) argue that unwanted social comparisons are sometimes corrected after being made instead of being avoided in the first place (see also Gilbert, 1991; Wilson & Brekke, 1994). The authors suggest that comparisons can be natural and effortless reactions to the behavior of others rather than mental operations that one chooses to perform.

At the same time, comparisons can be strategic and deliberate. In fact, most everyone will utilize social comparison when comparison serves current goals (e.g., Taylor & Lobel, 1989). For example, patients struggling with life threatening medical diagnoses routinely use comparison with less fortunate others to bolster psychological well-being (Taylor & Lobel, 1989).

People engage in social comparisons for a variety of reasons (Dijkstra et al., 2008). Historically, researchers proposed that people seek comparisons in order to accurately evaluate their abilities, that is, to acquire information about the self (e.g., Festinger, 1954). According to this idea, social comparisons serve the goal to reduce a state of uncertainty about one's standing. More recent theories suggest that people also engage in social comparison with the motives of self-improvement (learn from others and improve one's performance) and self-enhancement (preserve or enhance self-esteem; Wayment & Taylor, 1995; Wood, 1989). When social comparisons are drawn to self-improve, the aim will be to detect one's own deficits and to find strategies to make up for them. In contrast, in case of self-enhancement, the strategy underlying comparison is to preserve one's self-esteem.

When used in the context of learning, strategic social comparison tends to facilitate learning. In classroom situations, students mainly seek self-improvement by comparing with better performing others, even at the cost of a less positive academic self-concept (Dijkstra et al., 2008). Furthermore, people often choose to compare upward after experiencing failure in order to get hope and inspiration as well as to learn how they can improve their performance (Ybema & Buunk, 1993). People even choose upward comparison in order to achieve self-enhancement (i.e. increased positive self-evaluation) through self-improvement (Collins, 1996).

Given the contrast between the habitual operation of a personal predisposition to social comparison and the deliberate operation of strategic social comparison, how might comparison motives ultimately influence learner's choice of a learning partner? We propose that the influence of strategic social comparison motives will depend on a learner's predisposition to habitual social comparison. Because habitual actions are relatively context insensitive, we predict that comparison by learners predisposed to habitual social comparison will be relatively insensitive to strategic concerns. Rather, habitual comparison will remain constant regardless of strategic motive. In contrast, comparison by learners not predisposed to habitual social comparison will be unburdened by habit and will thus be able to accommodate strategic comparison motives. In other words, we predict that strategic social comparison motives will influence learning partner choice only among learners not predisposed to habitual social comparison.

Additionally, we expect that, in the context of learning partner choice, the influence of different strategic comparison motives (i.e. self-improvement, self-evaluation, and self-enhancement) will converge. Specifically, we expect that all three strategic motives will prompt the selection of a higher performing learning partner. Although these different strategic comparison motives do sometimes lead to divergent outcomes in other contexts, comparison with a high performing learning partner can satisfy all three motives in an educational context (Collins, 1996; Dijkstra, et al., 2008): For self-improvement, a highly knowledgeable learner is able to provide the most help. For self-evaluation, a highly knowledgeable learner provides a meaningful upper limit on performance. And, although self-enhancement might be served by downward comparison after assessments, self-enhancement is just as well or better served by improving one's own performance ahead of assessment, especially among learners with reasonable self-efficacy.

We tested our hypothesis in two studies in which we created the need to choose a future learning partner, in which we measured students' predisposition to habitual social comparison, and in which we measured participants' strategic motivation for comparison in support of self-improvement, self-evaluation, and self-enhancement. We then observed the effect of participants' predisposition to habitual comparison and participants' strategic motivation for comparison on participants' learning partner choice. In Study 1 we used a scenario methodology. In Study 2, we constructed an actual learning choice.

Study 4.1

Method

Participants and Design

An online questionnaire study with Social Comparison Orientation and strategic social comparison motives as continuous predictors was conducted. Participants received a lottery ticket for an online voucher of 5x20 € for compensation. In this and Study 2, individuals that had frequently participated in past studies and were potentially familiar with the study material, as well as participants who were non-native speakers, were excluded from analyses.[9] The final sample consisted of 150 participants (124 women, 26 men, M_{age} = 22.97 years, range: 18 - 34).

Procedure

Participants were invited to take part in two ostensibly separate studies: first some personality questionnaires and afterwards a scenario study. After receiving this information, participants completed the measures of habitual social comparison (i.e., Social Comparison Orientation) and strategic social comparison motives. Next, participants were asked to imagine that they had to pass a class involving two exams. Participants had scored a 2.7 (on a scale of 1 to 5, with 1 being the best and 5 being the worst possible score) in the first exam and now had five weeks before they have to take the final exam. Participants were then told that they could choose with whom they would like to prepare for the upcoming exam.

Participants saw the scores from the first exam of eleven potential learning partners. Out of these eleven choices, five potential learning partners scored higher than the participant (between 1.0 and 2.3) and five other potential partners scored lower than the participant (3.0 to 5.0). One final potential partner had the same score as participants. Participants than had to choose (a) who they would like to prepare with twice a week until the exam, and (b) who they would like to prepare with two days before the exam. We assessed partner choice twice in order to gain a more reliable estimate, analogous to including two scale items instead of a single item. After participants made their selections, we probed participants for suspicion about the experimental deceptions and debriefed them.

[9] These participants were excluded, because the text based materials required good language skills. Moreover, participants who had seen the materials before or have been debriefed about experimental manipulations in too many other studies, are likely to react differently to the current materials. Unfortunately, our participant pool did not allow to filter ahead of time according to these criteria.

Measures

Social Comparison Orientation. Social Comparison Orientation was measured with a validated German translation of Gibbons and Buunk's (1999) Iowa-Netherlands Comparison Orientation Measure (Jonas & Huguet, 2008, see Appendix II for items). A typical item is, "I often compare myself with others with respect to what I have accomplished in life." The 7-point scales accompanying the items were anchored at -3 (*I do not agree at all*) and +3 (*I fully agree*). Reliability of the Social Comparison Orientation scale was good (Cronbach's $\alpha = .76$, $M = 0.80$, $SD = 0.92$, range = -1.64 to + 2.55).

Strategic Social Comparison Motivation. We adopted Buunk et al.'s (2007) measure of strategic social comparison motives (see Appendix IX for items). The base scale consists of items designed to assess three different strategic social comparison motives – self-improvement, self-evaluation, and self-enhancement. Participants were asked to consider comparisons that they have or that they might draw and then respond to items such as, "when I compare myself with someone else, I do that to evaluate my own skills" (self-evaluation); "when I compare myself with someone else, I do that so I can get better" (self-improvement); "when I compare myself with someone else, I do that to make myself feel better" (self-enhancement). Responses are made on a five point scale anchored at 1 (*completely disagree*) and 5 (*completely agree*).

We analyzed Buunk, et al.'s (2007) measure of social comparison motives with confirmatory factor analysis. Across both Studies, we compared the intended three factor measurement model against an alternative single factor measurement model and against a two factor measurement model collapsing across the two most highly correlated constructs (self-evaluation and self-enhancement) in the three factor model (Table 1). Across indices of model fit, the three factor model performed consistently better than the one factor model and as well as or better than the two factor model. We thus retained the original three factor model.

Table 2: Summary of fit indices for social comparison motives resulting from confirmatory factor analyses, Study 1 and Study 2.

	Fit Indices		
Model	χ^2	RMSEA	AIC
Study 1			
Single Factor	260,20	0,18	304,20
Two Factor	128,73	0,12	174,73
Three Factor	110,71	0,11	160,71
Study 2			
Single Factor	177,36	0,20	221,36
Two Factor	119,78	0,15	165,78
Three Factor	101,57	0,14	151,57

Following the selection of an overall model, we then assessed the factor loadings of individual items. Four items showed poor factor loadings, defined as .59 or less across both studies or .39 or less in a single study (Table 2). These items were trimmed from the scales. The resulting assessments of self-improvement motives (Cronbach's α = .85, *M* = 3.38, *SD* = 0.95, range = 1 to 5), self-evaluation motives (Cronbach's α = .74, *M* = 3.58, *SD* = 0.78, range = 1 to 5), and self-enhancement motives (Cronbach's α = .75, *M* = 3.11, *SD* = 0.86, range = 1.33 to 5) all showed good reliability.

Table 3. Summary of factor loadings for social comparison motives, Study1 and Study2.

	Factor loadings	
Item	Study 1	Study 2
SIM1	0,86	0,91
SIM2*	0,48	0,50
SIM3	0,87	0,74
SIM4*	0,34	0,39
SEV1	0,78	0,65
SEV2	0,71	0,84
SEV3	0,63	0,54
SEV4*	0,36	0,36
SEN1	0,57	0,86
SEN2	0,83	0,65
SEN3	0,62	0,85

Learning Partner Choice. Learning partner choice was assessed twice with a single item on an eleven point scale ranging from 1 for a person who received the worst possible test score (5.0) to 11 for the person who received the best possible test score (1.0). We averaged across both selections, $r(98) = .517$, $p < .001$, in order to gain the more reliable measurement.

Results

We predicted that strategic social comparison motives would influence partner choice only among participants without a strong predisposition to habitual social comparison (i.e., among participants not high in Social Comparison Orientation). Additionally, in the context of collaborative learning with a potentially more knowledgeable partner, we expected that self-improvement, self-evaluation, and self-enhancement motives would all encourage the selection of a more capable study partner.

We initially assessed these predictions with a series of multiple regression analyses. We predicted participants' average learning partner choice from Social Comparison

Orientation, each strategic social comparison motive, and the interaction between Social Comparison Orientation and the specific strategic comparison motives. All predictors were mean centered. We began with separate multiple regressions evaluating the relationship between Social Comparison Orientation and the individual motives (Table 3). All three motives showed similar significant or marginal interactions with social comparison. We then assessed the unique influence of each motive by examining the relationship between Social Comparison Orientation and all three motives in a single regression analysis (Table 3). When considered together, each of the three interactions was reduced to non-significance. This analysis suggests that, although the motives are unique from one another, their influence on Social Comparison Orientation is shared. Given this shared influence, our final and primary analysis consisted of a single summary regression collapsing across the three distinct motives.

Table 4. Summary of the multiple regression analyses on learning partner choice with social comparison orientation (SCO), self-improvement (SIM), self-evaluation (SEV), self-enhancement (SEN), and combined social comparison motives (COM) as predictors, Study4.1.

	Standardized slopes								
Analysis	SCO	SIM	SEV	SEN	COM	SCOxSIM	SCOxSEV	SCOXSEN	SCOxCOM
Self-improvement	-0,09	-0,13	-	-	-	-.24*	-	-	-
Self-evaluation	-0,10	-	0,02	-	-	-	-0,12	-	-
Self-enhancement	-0,09	-	-	0,00	-	-	-	-0.31**	-
Motives jointly	-0,12	-0,16	0,03	0,08	-	-.34†	0,10	-.37*	-
Motive combined	-0,09	-	-	-	-0,01	-	-	-	-.26*

This final analysis predicted partner choice from Social Comparison Orientation, combined strategic social comparison motives, and the interaction between Social Comparison Orientation and combined strategic social comparison motives. Neither Social Comparison Orientation, $b = .08$, $SE = .10$, $p = .416$, nor strategic social comparison motives $b = .21$, $SE = .14$, $p = .147$, directly predicted learning partner choice. However, as expected, Social Comparison Orientation and strategic social comparison motives interacted to predict learning partner choice, $b = -0.25$, $SE = .11$ $p = .023$. This interaction is graphed in Figure 1.

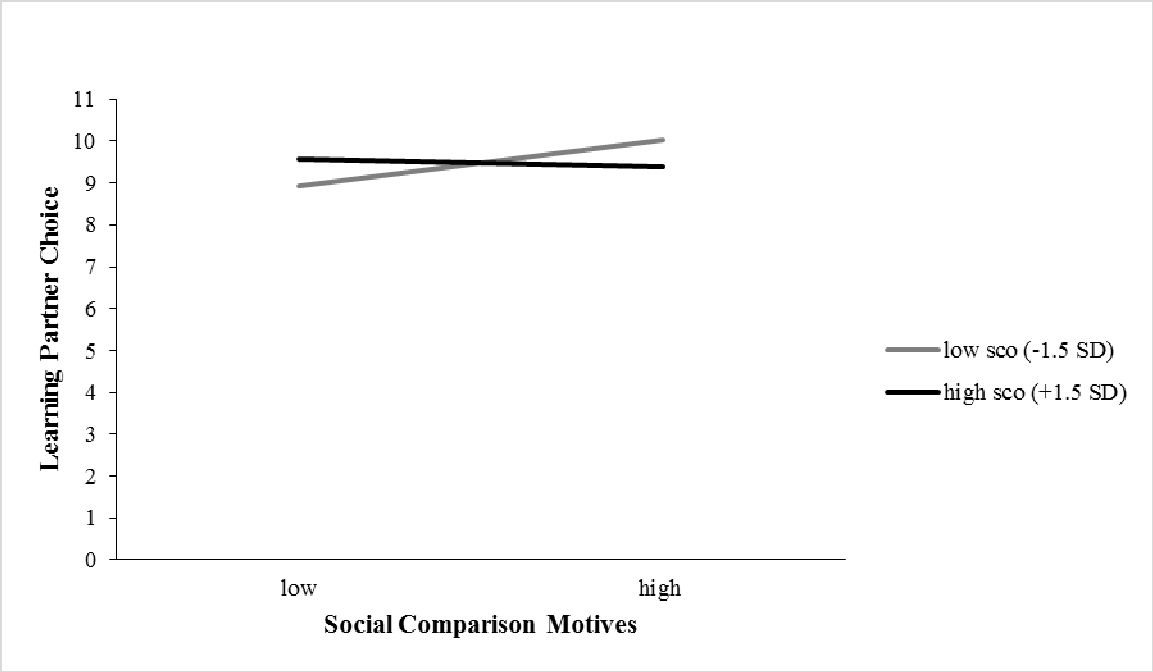

Figure 9. Learning Partner Choice by Social Comparison Motives and Social Comparison Orientation (SCO), Study4.1.

To better understand the nature of this interaction, we examined the influence of strategic comparison motives among participants high and low in Social Comparison Orientation. Specifically, we assessed the effect of strategic social comparison motives after shifting social comparison orientation one and a half standard deviations above and below its mean (Cohen et al., 2003). Note that this procedure is fully analogous to probing an interaction with simple comparisons in an ANOVA framework. As predicted, simple slopes analysis indicated that strategic social comparison motives led participants low in social comparison orientation to choose more capable learning partners, $b = .582$, $SE = .22$ $p = .007$. Also as predicted, participants high in social comparison orientation were insensitive to strategic social comparison motives in their choice of learning partner, $b = -0.10$, $SE = .19$ $p = .616$.

Discussion

The results of Study 1 conformed to our predictions. Strategic social comparison motives influenced learning partner choice only among individuals not predisposed to habitual social comparison. These results were obtained in reaction to a hypothetical scenario, however, and people do not always behave in the way that they predict. Study 2 aimed to make up for this deficit by creating a learning situation that required an actual rather than imagined choice about who to study with.

Study 4.2

Method

Participants and Design

An online study with Social Comparison Orientation and strategic social comparison motives as continuous predictors was conducted. Participants received a lottery ticket for online vouchers of 5x20 € as compensation. The final sample consisted of 80 individuals (62 women, 18 men, M_{age} = 23.81 years, range: 18 - 31).

Procedure

Participants were invited to a study with two parts, although participants only actually completed the first part. The first part of the study was accurately presented as consisting of (a) completing some personality measures and (b) selecting the person that participants wanted to cooperate with in the second part of the study. The second part of the study, which participants expected to take place but which never actually took place, was introduced as a learning task that participants would have to master in cooperation with the partner they chose in the first part of the study.

The study started with the assessment of participants' social comparison orientation (Cronbach's α = .76, *M* = 0.89, *SD* = 0.89, range = -1.55 to + 2.55) and strategic social comparison motives identical to that used in Study 1 (all α > .74). Next, participants completed a shortened version of the German Intelligence-Structure-Test 2000 R (Liepmann et al., 2007). Afterwards, they were asked to describe the strategy they used to work on the test in written form in order to give participants the impression that there was material to exchange between learners. All participants were told that they scored 72% on the intelligence test. Next, participants had to choose a person whom they would like to work with in a subsequent learning task. Analogously to Study 2, participants were presented eleven potential partners along with those partners' scores on the intelligence test. Out of these eleven choices, five potential learning partners' scored higher than the participant (between 78% and 98%), thus presenting five possible upward comparisons, and five potential partners scored lower than the participant (between 42% and 68%), thus presenting five possible downward comparisons. The final potential partner had the same score as the participant. Participants then chose a single learning partner to cooperate with in the future. As in the Study 1, participants' choice was then translated to an 11-point scale. After participants made their choice, the study ended with demographic items, probes for suspicion about the experimental deceptions, and a debriefing.

Results

As in Study 1, we expected that participants who were predisposed to habitual social comparison (i.e., high in Social Comparison Orientation) would not adjust their choice of learning partner according to strategic social comparison motives. In contrast, we expected participants not predisposed to habitual social comparison (i.e., low in Social Comparison Orientation) to adjust their choice of learning partner according to their strategic social comparison motives. As in Study 1, we also expected self-improvement, self-evaluation, and self-enhancement motives to converge on selecting a more capable study partner.

We used the same analysis strategy employed in Study 1. We began with separate multiple regressions evaluating the relationship between Social Comparison Orientation and the individual strategic motives (Table 4). Self-improvement and self-enhancement again showed similar and significant interactions with Social Comparison Orientation. The slope of the interaction between self-evaluation and Social Comparison Orientation was also descriptively similar, although non-significant. We then assessed the unique influence of each motive by examining the relationship between Social Comparison Orientation and all three motives in a single regression analysis (Table 4). When considered together, the slope of the interactions for both self-improvement and self-evaluation increased in magnitude although the associated standard errors increased more proportionally. The larger slopes were thus associated with larger p-values when considered together than when considered separately. Although individual predictors remained significant in this analysis, the pattern of inflated variance is similar to that observed in Study 1 and also suggests substantial shared influence between the different strategic social comparison motives on learning partner choice. Given the descriptive similarity across the operation of the three strategic motives and given the suggestion of shared influence, our final analysis again consisted of a single summary regression collapsing across the three distinct motives.

Table 5. Summary of the multiple regression analyses on learning partner choice with social comparison orientation (SCO), self-improvement (SIM), self-evaluation (SEV), self-enhancement (SEN), and combined social comparison motives (COM) as predictors, Study4.2

	Standardized slopes								
Analysis	SCO	SIM	SEV	SEN	COM	SCOxSIM	SCOxSEV	SCOXSEN	SCOxCOM
Self-improvement	-0,09	-0,13	-	-	-	-.24*	-	-	-
Self-evaluation	-0,10	-	0,02	-	-	-	-0,12	-	-
Self-enhancement	-0,09	-	-	0,00	-	-	-	-0.31**	-
Motives jointly	-0,12	-0,16	0,03	0,08	-	-.34†	0,10	-.37*	-
Motive combined	-0,09	-	-	-	-0,01	-	-	-	-.26*

This final analysis predicted partner choice from Social Comparison Orientation, combined strategic social comparison motives, and the interaction between Social Comparison Orientation and combined strategic social comparison motives. Neither Social Comparison Orientation, b = -.24, SE = .33, p = .472, nor strategic social comparison motives b = -.01, SE = .43, p = .955, directly predicted learning partner choice. However, as expected, Social Comparison Orientation and strategic social comparison motives interacted to predict learning partner choice, b = -0.84, SE = .36 p = .021. This interaction is graphed in Figure 2. As expected, simple slopes analysis indicated that strategic social comparison motives led participants low in social comparison orientation to tend towards more capable learning partners, b = 1.26, SE = .69 p = .071. In contrast, participants high in social comparison orientation tended towards selecting less capable learning partners when strategically motivated to engage in social comparison, b = -.99, SE = .59, p = .096.

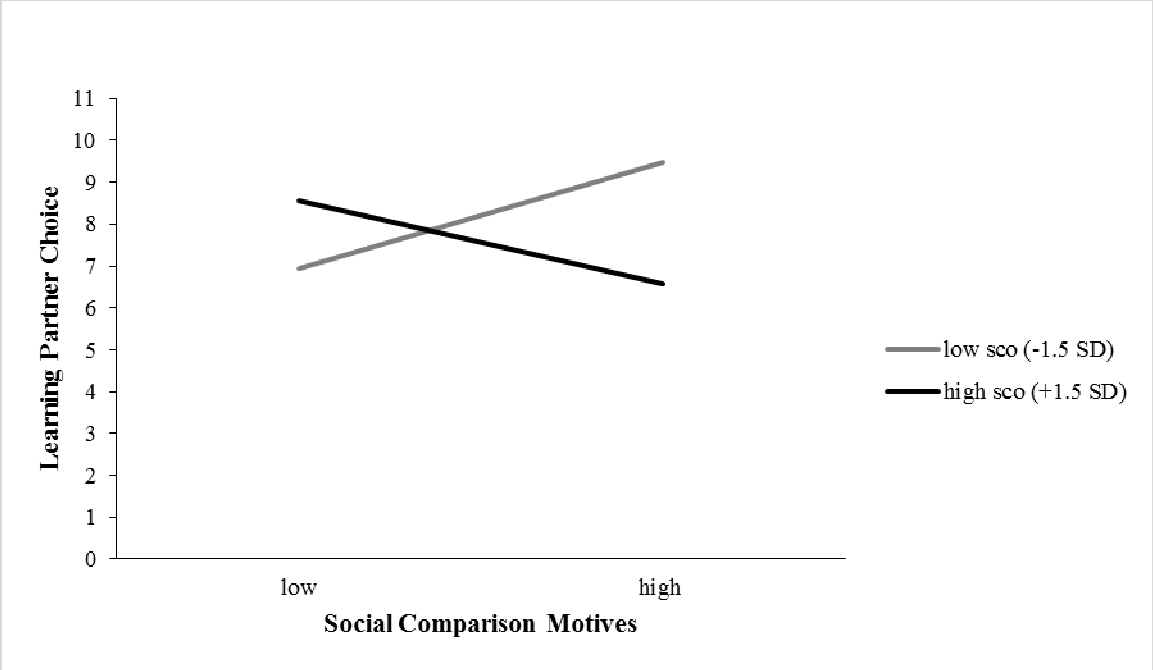

Figure 10. Learning Partner Choice by Social Comparison Motives and Social Comparison Orientation (SCO), Study4.2.

Discussion

As in Study 1, people who were predisposed to habitually engage in social comparison reacted to strategic social comparison motives differently. Importantly, this interaction occurred in response to people's actual choice of a learning partner for a coming learning task.

The specific form of the interaction observed in Study 2 was generally consistent with predictions and with the results of Study 1. There was, however, also a trend for people who

were predisposed to habitual social comparison to select less capable partners in response to social comparison motives. Looking across Studies 1 and 2 together, it seems unlikely that the trend is reliable. Rather, the combined results suggest that people predisposed to habitual social comparison appear relatively insensitive to strategic social comparison motives where as people not predisposed to habitual social comparison seek more capable learning partners as a results of strategic social comparison motives.

General discussion of Chapter 4

The current research sought to illuminate the influence of social comparison motives on who learners choose to learn with. We expected that habitual and strategic social comparison motives would interact to affect learners' choice of learning partner. Specifically, we expected that a predisposition to habitual social comparison would make learners insensitive to the influence of strategic comparison motives. Both studies converged to support this hypothesis; Study 1 provided support with an imagined scenario based on participants' past experiences and Study 2 provided support in the context of an actual decision about who participants wanted to work with on a future task. A habitual tendency towards social comparison thus appears to negate the beneficial effects of strategic social comparison motives when students choose their own learning partners.

In this specific context, diverse strategic social comparison motives converged in their consequences. Each of self-improvement motives, self-evaluation motives, and self-enhancement motives all appeared to encourage participants to select more capable learning partners. In other contexts, these different motives are not necessarily interchangeable. For example, as observed here, self-improvement motives often prompt comparison with more capable others when people see their future performance as malleable. In contrast, however, in different contexts in which people think they cannot improve their future performance, self-enhancement motives can prompt people to avoid those same comparisons (Lockwood & Kunda, 1997). Although strategic social comparison motives can have divergent consequences in different contexts, we see no reason why habitual social comparison would not uniformly override strategic social comparison motives in such contexts.

Habitual social comparison is an individual difference assessed by Social Comparison Orientation. As in any design relying on the measurement of individual differences, it is possible that other personality traits might be confounded with Social Comparison Orientation and might thus have been responsible for the observed results. However, the scale that we used to assess Social Comparison Orientation has been well validated in past work (Buunk, et

al., 2007; Gibbons & Buunk, 1999; Jonas & Huguet, 2008; Neugebauer et al., 2016; Ray et al., 2013). We are thus confident that the observed effects are rooted in Social Comparison Orientation.

We tested our hypotheses in an experimental setting. It is thus reasonable to wonder if our observations will generalize to more naturalistic contexts, for example, face-to face collaboration in classroom settings. We would expect that naturalistic settings differ from experimental contexts primarily because they bring to bear additional competing motives and influences (e.g., affiliation motives). The basic processes we explore do operate in real classrooms, however (Dijkstra et al., 2008). We would therefore expect our findings to generalize to richer social contexts, however, this expectation can only be confirmed through further empirical investigations.

Our findings here join a growing body of work exploring the importance of Social Comparison Orientation in cooperative learning. Past work has demonstrated that Social Comparison Orientation can lead to counterproductive choices by more knowledgeable learners during cooperative learning. Knowledgeable learners who are predisposed to habitual social comparison tend to withhold knowledge from less knowledgeable learning partners, thus hurting their own and their partners' learning (Ray, et al., 2013). When making use of a more knowledgeable learning partner however, Social Comparison Orientation encourages the effective uptake of information (Neugebauer et al., 2016). Overall then, learners' predisposition to habitual social comparison appears to undermine cooperation by more knowledgeable learning partners and to prevent strategic social comparison motives from encouraging learners to select learning partners who are more knowledgeable than themselves. Once paired with a more knowledgeable learning partner, however, Social Comparison Orientation does encourage effective use of information provided by a more knowledgeable peer.

One potential way to overcome the problematic effects of Social Comparison Orientation might be mindfulness training (Langer et al., 2010). Langer and colleagues (2010) tested the effectiveness of mindfulness treatments as a buffer against negative self-evaluations after social comparison on creative tasks. Participants were more positive in evaluating their own performance after mindfulness training. Although the evaluation of creative tasks is a different domain, it would be informative to explore if mindfulness might have similarly beneficial effects in the context of knowledge exchange between learners.

A students' learning and performance strongly depends on whom they learn with. Higher performing learning partners provide a higher potential for others and also benefit

from sharing their knowledge with less capable learners (Webb, 1989, 1991). However, habitual social comparison can prevent students from seeking the most effective partner with whom to learn. Recognizing and managing the different impacts of habitual and strategic social comparison motives provides an important avenue by which collaborative learning can be improved.

Chapter 5: General Discussion

The current dissertation addressed diverse aspects of social comparisons in collaborative learning: learner's engagement when learners are aware of their learning partner's knowledge and comparison options are constrained as well as learning partner choices when comparison options are unconstrained before collaboration. By doing so, this dissertation combined social psychological insights on social comparison theory with educational psychological research on collaborative learning.

In the first empirical chapter (Chapter 2) I demonstrated the influence of social comparison tendencies on the engagement of more knowledgeable learners depending on their awareness of a learning partner's knowledge level. I tested this influence in a series of experiments in which participants provided explanations to an ostensible learning partner with or without knowledge awareness. Both dispositionally and situationally motivated social comparisons interacted with knowledge awareness to reduce information sharing in explanation. Intriguingly, knowledge awareness uniformly facilitated adaptation of the information that was shared to address partner knowledge deficit. These results illustrate a tension in the components of effective explanation. At the same time that knowledge awareness effectively coordinates explanation content, it can lead to knowledge hoarding by knowledgeable explainers who are motivated to rely on knowledge differences between the self and the learning partner for self-evaluation. In sum, these results provide first evidence for the facilitation of social comparisons by knowledge awareness and thereby address a gap in social and educational psychological research, especially in computer-supported collaborative learning.

Whereas I demonstrated the influence of social comparisons by more knowledgeable learners in Chapter 2, the second empirical part (Chapter 3) showed how less knowledgeable learners change their engagement in response to knowledge awareness if they are predisposed to rely on social comparisons for self-evaluation. In two experiments I staged a cooperative learning task, assessed participants' predisposition to social comparison, manipulated participants' awareness of learning partner knowledge, and observed the consequences for participants' engagement and learning outcomes. In both experiments, knowledge awareness helped learners to match their explanation requests to a learning partner's superior knowledge. At the same time, less knowledgeable learners motivated to engage in social comparisons showed higher learning engagement and learning outcomes as a result of knowledge awareness. These results expand my previous findings by showing that knowledge awareness does not in itself harm learning but can also facilitate more learning engagement by less

knowledgeable learners; providing an effective opportunity to further support learner engagement in collaborative learning.

In the first two empirical chapters, I demonstrated that social comparisons can heavily influence a learners' engagement and learning in collaborative environments that provide knowledge awareness. Hence, the questions arose how early in collaboration social comparisons influence learners' behavior. In order to clarify, I investigated social comparisons before collaboration; that is, when learners can decide for themselves who they would like to learn with. Thus, whereas the first two empirical parts (Chapters 2 and 3) demonstrated the influence of social comparisons when comparison options are constrained, the last empirical chapter (Chapter 4) concentrated on the influence of habitual and strategic social comparisons on learning partner choices when comparison options are unconstrained. In two studies I measured students' habitual and strategic social comparison motives in the context of an upcoming cooperative learning task. Then, I observed the influence of habitual and strategic social comparison motives on students' choice of learning partner for the upcoming task. Across both studies, I found that only participants who were *not* predisposed to habitual social comparison benefited from strategic social comparison motives. These participants chose the learning partner who provided the highest learning potential for them. However, if learners were predisposed to rely on comparisons they did not choose their learning partner in relation to their strategic motives. These learners did not choose the learning partner that provided the highest learning potential even though this would have been in accordance with their strategic motives. Thus, with this work I shed light on another aspect of social comparisons' influence in collaborative learning, namely, learning partner choices. More specifically, I demonstrated that social comparisons already influence learners before actual collaboration.

In conclusion, it was shown that social comparisons strongly influences learners' engagement in collaborative learning as well as their preference for learning partners. For more knowledgeable learners social comparisons can lead to detrimental self-evaluation defense, whereas less knowledgeable learners can benefit from comparisons with their peers. Furthermore, if given the choice, learners that are predisposed to use others for comparison tend to ignore their strategic social comparison motives and avoid choosing the best possible learning partner option.

Strengths and limitations

This dissertation was a first attempt to address the influence of social comparisons in computer-supported collaborative learning as well as the interaction of habitual and strategic social comparison motives. By using experimental as well as correlational designs, dispositional as well as situational social comparisons, and diverse outcome measures, this dissertation provided basic and valuable insights into the topic at hand.

Forced social comparisons: when comparison options are constrained

In Chapter 2 and 3 I concentrated on the influence of social comparisons on learner engagement and learning outcome when comparison options are constrained. I demonstrated that knowledge awareness can lead to knowledge hoarding and lower learning outcome by more knowledgeable learners as a consequence of self-evaluation defense. At the same time knowledge awareness can lead to higher engagement and learning outcome as a response to an upward comparison target by less knowledgeable learners. An important strength of my research approach was the experimental design wherein I manipulated participants' awareness of a learning partner's knowledge and observed the effects on learner engagement and learning. Furthermore, the usage of chronic (social comparison orientation) as well as situational social comparisons in Chapter 2 is a clear strength of this work. This way, it was possible to ensure that social comparison is driving the observed effects instead of alternative factors. Whereas this link is missing in Chapter 3, I would expect social comparisons introduced by knowledge awareness to work likewise in cases of comparisons by less knowledgeable learners. After all, the measure I used to assess participants' predisposition to social comparisons (social comparison orientation) has been well validated in previous work (e.g. Buunk et al., 2007; Gibbons & Buunk, 1999). However, this shortcoming still needs to be addressed empirically through situational manipulation of social comparisons when learners become aware of superior partner knowledge.

The sum of findings from Chapter 2 and 3 indicates that social comparisons can have diverse outcomes for learners in CSCL. Through this, I provided previously disregarded insights into learner collaboration; a further strength of this dissertation. In a first step, these chapters explored the influence of a learner's dispositional as well as situationally motivated social comparisons on learners' engagement and learning outcomes for less and more knowledgeable learners separately. For more knowledgeable learners I found social comparisons facilitated by knowledge awareness to be detrimental for learning. Not only did

more knowledgeable learners, who tended to compare themselves to others, show less engagement in learning, they also achieved lower learning outcome than learners who did not tend to use others for such comparisons. In contrast, for less knowledgeable learners, social comparison facilitated by knowledge awareness led to the opposite effect: less knowledgeable learners showed more engagement and higher learning outcome if they tended to use others for comparison compared to learners who did not show this disposition. However, a question I did not address here is how to manage these opposing effects. Therefore, potential solutions will be discussed in the following chapter.

Furthermore, due to the controlled settings in the studies discussed above it is still up for further investigation to observe the influence of social comparisons in actual collaboration. A clear strength of these studies is that I introduced participants to fictitious learning partners through a fictitious computer network in order to minimize alternative explanatory factors. Therefore, participants had no further interaction with their learning partners besides the information about their knowledge and the explanations participants received from them. This allowed me to clearly examine the relationship between social comparison motives and knowledge awareness. However, it is unclear how other factors, such as visual or verbal feedback, would influence learners' engagement and behavior in richer environments. Clearly, future research should seek to address this shortcoming and demonstrate the influence of social comparisons on learners' engagement and learning in richer collaborations, such as face-to-face collaborative learning.

Free social comparisons: when comparison options are unconstrained

In Chapter 4 I demonstrated how learners' (habitual) tendency to use others for social comparisons and other (strategic) comparison motives interact in choosing a learning partner when comparison options are unconstrained. Whereas research so far concentrated on social comparison choices (for an overview see Dijkstra et al., 2008), this dissertation demonstrated the influence of social comparison motives on choosing not only a comparison target but a potential learning partner. Additionally, this dissertation was a first attempt to clarify the interaction of habitual and strategic social comparison motives. A vast amount of research focused on the influence of social comparison orientation as an individual predisposition to use information about others for social comparison or social comparison motives and who people consequently choose to compare with solely (for a review see Dijkstra et al., 2008). The research discussed in Chapter 4 integrated these research lines and showed that learners who were predisposed to use information about others for social comparisons chose lower

performing learning partners than learners who were not predisposed in such way even if they showed high strategic motivation. Thus, a strength of this dissertation lies in demonstrating the tension in diverse social comparison motives and therewith providing valuable insight into the interaction of these motives.

Furthermore, in reference to the previously discussed findings the observed influence of social comparison on learning partner choices can actually be detrimental for the effectiveness of knowledge awareness. One benefit of knowledge awareness that I demonstrated is that learners who are predisposed to rely on social comparisons and are less knowledgeable than their learning partner can gain most from collaborative learning through their heightened engagement. In Chapter 4 I showed that these same learners, if given the choice before collaboration, do *not* choose high performing learning partners who would provide the knowledge learners would need in order to improve. Therefore, a further strength of this empirical part is that implications for collaborative learning settings with knowledge awareness can be derived: giving learners learning partner choices before collaboration which includes providing knowledge awareness might counteract the benefits of same learning environments. Indeed, if learners choose learning partners with comparable performance levels as their own they might not even feel the need to improve and consequently learn less.

Besides these strengths it must be noted that the research conducted in Chapter 4 did not include a systematic manipulation of the independent variables (social comparison orientation and social comparison motives). Due to this shortcoming, it is not possible to be certain of a causal direction from habitual and strategic social comparison motives to the observed learning partner choices. Although unlikely, it is possible that learning partner choice could subsequently influence a learners' social comparison motives. Therefore, it is necessary for future research to address this shortcoming by clarifying the causal link between comparison motives and learning partner choices through an experimental approach. For example, by applying the feedback approach used in the first empirical chapter of this dissertation to prompt situationally motivated comparisons. If comparable effects can then be observed, one could indeed draw the conclusion that habitual and strategic comparison motives do influence learning partner choices the way I observed in the reported studies.

Furthermore, a link missing in the current dissertation is how the observed learning partner choices influence a learners' engagement and learning in collaboration. I argued that learners do not choose to learn with the most knowledgeable partner in order to prevent a self-threatening upward comparison. Upward comparison can be self-threatening if the comparison targets' performance or knowledge level seems unattainable (e.g. Lockwood &

Kunda, 1997; Muller & Fayant, 2010). Then, threatening upward comparisons can have diverse effects on learners. A vast amount of research demonstrated that upward comparisons can lead to negative affect, such as dissatisfaction, frustration, and fear (e.g. Gastorf & Suls, 1978; Tesser & Collins, 1988). Additionally, not reaching a certain standard (i.e. an upward comparison target) could elicit ruminative thoughts and potentially distract learners from engaging in a task (Muller & Butera, 2007). Thus, it might be helpful for learners who use others for social comparison to not choose the highest performing learning partner and thereby preventing distracting ruminative thoughts. These learners might indeed perform worse if presented with a self-threatening learning partner. How learners' engagement and learning in collaboration is actually influenced by their learning partner choice should thus be the focus of future research.

Despite these limitations, the discussed results contribute to prior research in numerous ways. Research on (computer-supported) collaborative learning was extended by showing that knowledge awareness, a highly effective support for collaboration, introduces social comparisons and thus new unconsidered problems into collaborative learning environments. Furthermore, this work contributes to research on social comparison theory by demonstrating how diverse social comparison motives interact and influence learning partner choices in collaboration. Therefore, these contributions will be discussed in detail next.

Theoretical implications

The current dissertation contributes to both social psychological and educational research. From knowledge that was gained through this research implications for future research on the interplay of social comparison in collaborative learning and research on computer-supported collaborative learning as well as social comparison theory can be drawn.

Implications for research on social comparisons in collaborative learning

According to my findings, it would be promising to promote upward comparisons while inhibiting downward comparisons when learners collaborate. One option in order to achieve such specific circumstances would be to use the moderating factor introduced in Chapter 3, namely information diagnosticity. I demonstrated that if learners are given information about a learning partner that suggests them to be non-diagnostic, learners do not utilize this information for social comparisons. If then presented with an upward comparison

target learners did not show heightened engagement in learning. Thus, social comparison mechanisms were inhibited in these cases. Therefore, it might be beneficial to investigate this moderator in collaborative settings in which downward social comparisons are facilitated by knowledge awareness. If these investigations then provide evidence for inhibited downward comparisons through the manipulation of information diagnosticity, this might suggest a starting point for managing the detrimental effects downward comparisons can have for learners' engagement and consequent learning.

Another option would be to reduce or inhibit the influence of social comparisons altogether. In a recent review Landkammer and Sassenberg (2016) summarized research demonstrating social influence on information exchange in computer-mediated communication depending on the salience of a joint social identity. The authors discussed and demonstrated that the negative influence of diverse egocentric tendencies can be inhibited if a joint social identity (e.g. a group goal) is salient. For example, in previous research individual evaluation bias (i.e. discounting information that contradicts and appreciating information that supports one's own decision; Nickerson, 1998) has been associated with lowered group decision quality (Greitemeyer & Schulz-Hardt, 2003). Following this observation, Sassenberg, Landkammer, and Jacoby (2014) investigated how self-regulation foci compared to a group goal influence the occurrence of such bias. They showed that a heightened evaluation bias facilitated by participants' prevention focus (i.e. a general need for safety and security, Higgins, 1997) was minimized if participants were provided with a group goal. Interestingly, group goals that are related to performance generally increase group outcomes by shifting attention from individual to group performance (DeShon, Kozlowski, Schmidt, Milner, & Wiechmann, 2004; Kleingeld, van Mierlo, & Arends, 2011).

Therefore, focusing learners on their social identity (e.g. a group goal) might also shift their attention from social comparison information and individual performance to their group's performance. Landkammer and Sassenberg (2016) proposed that people might in turn concentrate on a comparison with an outside group and would use their group members as resources for knowledge in order to surpass not each other but another group. Thus, providing learners with a group goal and therewith shifting their attention away from their social comparisons might diminish the observed influence of this individual disposition. However, this would also impair the heightened engagement facilitated by upward social comparison demonstrated in Chapter 3. Consequently, researchers investigating the effectiveness of group goals in diminishing social comparison effects should balance the positive influence of such goals against the positive influence of a learner's upward social comparisons.

A further question that arises from the found relations is what might happen if learners who both tend to compare partake in the same collaborative group. Thus, how would learners collaborate if the less knowledgeable learner heightens engagement whereas the more knowledgeable learner withholds their knowledge in order to maintain their superiority as a consequence of social comparisons? Clearly, these circumstances would provide the potential for intragroup conflict: "the process emerging from perceived incompatibilities or differences among group members." (De Wit, Greer, & Jehn, 2012, p.360; see also: De Dreu & Gelfand, 2008). More precisely, relationship conflicts might be facilitated. Relationship conflicts derive from interpersonal incompatibilities and involve feelings such as annoyance, frustration, and irritation among group members (e.g. Amason, 1996; Jehn & Mannix, 2001). Indeed, in the collaboration described above, the less knowledgeable learner might develop these feelings as a consequence of their partners' knowledge withholding. Interestingly, in a meta-analysis De Wit and colleagues (2012) found that relationship conflicts are negatively related to group performance. Therewith, the authors support De Dreu's (2006) proposition that relationship conflicts reduce collaborative problem solving and therefore can harm group performance. This indicates that collaboration of two learners who use information about others for social comparison might be detrimental for consequent learning. However, further empirical investigations are needed in order to clarify how and if such collaborations do indeed facilitate intragroup conflicts and consequently harm learning.

In another vein, the results observed for upward comparisons by less knowledgeable learners are in line with results observed when people assimilate to their comparison target (e.g. Collins, 1996; Mussweiler, 2003). If learners comparison choices are constrained, one can either test for differences between oneself and a given comparison target or test for similarities. The former testing leads to contrasting: the tendency to overestimate differences between oneself and a comparison target (Collins, 1996; Mussweiler, Rüter, & Epstude, 2004). Such contrasting is often perceived as self-threatening and can lead to task-disengagement and lowered achievement (Muller & Fayant, 2010). The latter testing generally results in assimilation: the tendency to overestimate similarities between oneself and a comparison target. Interestingly, assimilation can be associated with upward comparisons and consequently lead to heightened effort and better performance (e.g. Collins, 1996; Dijkstra et al., 2008).

Whether people assimilate towards or contrast away from a given standard partly depends on the extremity of the comparison standard. Lockwood and Kunda (1997) found that people's reaction to a role model depends on whether or not they think they can obtain

the same status as the comparison target. Only when the role model's performance seemed attainable did participants feel inspired and self-enhanced. The fictitious learning partners used in the current dissertation might have presented such attainable targets. The simple fact that the learning partner achieved more knowledge after the same learning phase as the participants may have led to inspiration and therewith higher engagement. Thus, it is plausible that learners in my studies assimilated to their comparison target and consequently increased their effort. However, this assumption can only be verified through further empirical investigation.

Contributions and implications for research on collaborative learning

Research on collaborative learning has focused on structuring and supporting collaboration in school to identify boundaries and opportunities for learners' performance. Especially in computer-supported collaborative learning (CSCL) researchers developed diverse awareness tools in order to ease learners' interaction. Research so far has neglected the influence of social psychological phenomena in CSCL. In this dissertation I applied social comparison theory to collaborative learning by observing social comparison effects when comparison options in collaborative learning are constrained (Chapter 2 & 3). Throughout this research I identified new unconsidered problems for effective collaboration between learners. More precisely, I identified social comparison as a potential moderator of previously found effects in CSCL. This suggests that, whereas awareness tools might support knowledge exchange and communication for some learners, the same tools might be detrimental for learning by others who use the information about their learning partner for social comparisons.

The demonstrated effects are likely to be true for other tools that are used to support knowledge exchange as well as effective learning. In a recent study, Kozlov, Engelmann, Buder, and Hesse (2015) tested the influence of a more complex knowledge awareness tool, namely Content-based Knowledge Awareness (CoKA), on task-solving efficacy and learning gains. CoKA tools allow online collaborating groups to provide others with a representation of the task-relevant knowledge they hold at the beginning of the collaboration task (e.g. Engelmann & Hesse, 2010). Kozlov and colleagues (2015) expected groups with CoKA to be more effective in learning in terms of learning speed and to show higher learning gains in a subsequent memory test. Surprisingly, they found the opposite effect: participants working collaboratively were not only slower in learning than individually learning participants, they

also did not achieve higher learning gains. I would expect these observations to be outcomes of social comparison processes that were facilitated through CoKA.

For example, individually learning participants needed half as long as participants in the group conditions. If social comparison processes were active this might point to the aforementioned ruminative thoughts (Muller & Butera, 2007) by learners who are faced with social comparison information. Interestingly, Kozlov et al. (2015R) also point out that participants in the CoKA condition reported overall less positive attitudes towards collaboration than other participants. As mentioned above, less positive attitudes were also observed as an outcome of social comparison processes (e.g. Gastorf & Suls, 1978; Tesser & Collins, 1988). Thus, it is plausible for social comparison processes to be responsible for the observed effects. For clarification, future research should further investigate the influence and occurrence of social comparisons in computer-supported collaborative learning environments such as Content-based Knowledge Awareness.

In another vein, social comparisons may not be the only social psychological phenomena that can be facilitated in collaborations where learners are provided with knowledge awareness. Social comparisons are closely related to learners' achievement goals (e.g. Bounoua et al., 2012; Butler, 1992, 2000; Régner et al., 2007). Achievement goals describe the purpose and aim of competence-relevant behavior and are traditionally distinguished between performance goals, thus aiming to demonstrate competence relative to others, and mastery goals, that is aiming to develop competence through mastering a task (Dweck, 1986; Nicholls, 1984). More recent research suggests a further distinction in relation to their valence (i.e. approach and avoidance forms of regulation), introducing a 2x2 achievement goal framework (Elliot & McGregor, 2001). Whereas with a performance-approach goal students aim at approaching doing better than others, with a performance-avoidance goal students aim at avoiding incompetence relative to others. Furthermore, the aim of a mastery-approach goal is to develop competence, whereas a mastery-avoidance goal encompasses maintaining or avoiding losses in competence (e.g. Bounoua et al., 2012; Elliot & McGregor, 2001). Interestingly, achievement goals are associated with diverse outcomes for learners (for a review see Van Yperen, Blaga, & Postmes, 2015). In a meta-analysis Van Yperen and colleagues (2015) found that achievement-approach (both performance and mastery) goals were generally associated positively with performance attainment in education. However, both achievement-avoidance goals were linked negatively to performance attainment, leading to further negative outcomes next to low performance such as anxiety, help-avoidance, and disinterest (Van Yperen et al., 2015; see also Van Yperen, 2006).

Various researchers recently demonstrated that achievement-oriented students based their perception of competence on social comparisons (Chatzisarantis et al., 2016; Van Yperen & Leander, 2014), demonstrating a clear relation between the two concepts. Thus, besides social comparisons, knowledge awareness might also facilitate learners' achievement goals. Interestingly, if confronted with an upward comparison learners with achievement-approach goals reported lowered performance-self-evaluations than learners who were confronted with favorable (downward) social comparisons (Van Yperen & Leander, 2014). Therewith, knowledge awareness might also introduce the potential for negative outcomes associated with diverse achievement goals. Of course, further research is needed in order to clarify, if collaborative settings that include providing knowledge awareness to learners also facilitate aforementioned goals.

Furthermore, past research has mostly neglected to observe who learners choose to learn with in collaboration. A few studies have shown that learners' mood or the popularity of their potential collaboration partner might influence who learners choose as their learning partner (Forgas, 1991; Gommans et al., 2015). Interestingly, Gommans et al. (2015) also showed that choosing a popular student as a collaboration partner can positively influence knowledge gain of a less popular student. However, research on the influence of social comparisons was missing in current research. In this dissertation I filled this research gap by demonstrating how diverse social comparison motives influence learners' collaboration partner choices. Chapter 4 demonstrated that the habitual predisposition to use information about others for social comparison overrules other strategic comparison motives. This in turn prevented learners from seeking the most effective partner with whom to learn. Thus, further integration of social psychological phenomena, such as social comparisons, into theories of (computer-supported) collaborative learning, seems a promising avenue to broaden the understanding of how, why, and with whom learners' engage in learning while collaborating.

Contributions and implications for research on social comparison theory

Social comparison theory has been thoroughly investigated in the past decades. Amongst other things, researchers identified individual differences in the tendency to use others for social comparisons (e.g. Gibbons & Buunk, 1999) as well as strategic social comparison motives (e.g. Dijkstra et al., 2008; Festinger, 1954; Wayment & Taylor, 1995; Wood, 1989). Whereas previously these lines of research were followed separately, I integrated research on diverse social comparison motives and observed their interaction when choosing learning partners. Therein, I demonstrated how learners who are predisposed to

habitual social comparisons are relatively insensitive to strategic concerns. As discussed above, this might be due to learners protecting against self-threatening social comparisons.

Therefore, I identified a tension between habitual and strategic social comparison motives that has not been considered in previous work and by this expanded social comparison theory. Of course, the habitual nature of people's predisposition to use others for social comparisons needs further investigation in order to shed light on its concrete mechanisms. Also, I suggested the idea of overcoming the observed problematic effect of predispositional social comparisons with mindfulness training (Langer et al., 2010). Introducing mindfulness research into social comparisons theory is a potential new path for future research. Thus, this dissertation presents a promising starting point for subsequent investigations. The present findings underline that the consideration of the interacting effects of diverse social comparison motives contributes to a better understanding of learners' collaboration partner choices in school.

Social comparisons have significant influence not only on one-to-one learning settings but also on broader school conditions. Interestingly, social comparisons are strongly connected to students' academic self-concepts depending on the average ability level in their school. Marsh (1987) first observed that students with the same ability level have lower academic self-concepts when they attend higher ability schools than when they attend lower ability schools. This finding is generally referred to as the big-fish-little-pond-effect (BFLPE; Marsh, 1987; see also: Dai & Rinn, 2008; Seaton, Marsh et al., 2008). The BFLPE has since been investigated to a great extent and is "associated with negative effects on students' academic choices, academic efforts, and subsequent achievement." (Huguet, Dumas et al., 2009, p.157; Marsh, 1987; Marsh & Yeung, 1997). Seaton and colleagues (2008) suggested that this effect results from forced upward comparisons with an entire class or school. Whereas students might have a comparison choice in one-to-one settings, they cannot as easily choose to be in a different class or school.

The circumstances investigated by these authors show clear parallels to the work reported in this dissertation. Surprisingly, the resulting effects seem to contradict each other at first glance. Whereas research in the BFLPE showed a negative effect of high ability schools on a students' self-concept and consequently lowered effort and achievement (e.g. Huguet et al., 2009), I demonstrated heightened engagement and learning outcomes when students compare their knowledge to more knowledgeable (i.e. higher achieving) learning partners (see Chapter 3). Fortunately, Huguet and colleagues (2009) analyzed the potential coexistence of upward social comparisons and the BFLPE as well as their diverse effects on students'

achievement in a comprehensive study. First, they demonstrated that the BFLPE is indeed a consequence of social comparisons by students with their class as a whole. Perhaps more important here, the authors also connected the BFLPE to contrast effects as well as upward comparisons to students' assimilation with their individual comparison choice in class. As mentioned above, students' contrasting in comparison to assimilation with their comparison target can lead to opposing effects on students' learning and achievement. Thus, the positive outcome of upward comparisons observed by me, if indeed stemming from assimilation processes, does not contradict the BFLPE per se. This idea is further supported by Huguet and colleagues (2009): after controlling for students' comparison-level choice and academic self-concept, the negative contrast effects (BFLPE) became even stronger; suggesting that the positive influence of students' upward comparisons stemming from assimilation partially eliminated the BFLPE. However, in neither Huguet et al.'s (2009) nor my work, learners' assimilation was directly assessed. Thus, future research on the interplay of social comparisons and the BFLPE should manipulate or at least assess this underlying factor in order to disentangle the unique influence of social comparisons in class settings.

Furthermore, implications for the BFLPE can be derived from the current dissertation. As mentioned above, social comparisons are clearly driving effects observed in BFLPE research (e.g. Huguet et al., 2009; Seaton et al., 2008). Therein, upward comparison assimilation seem to counteract the BFLPE. However, a link missing in current BFLPE research is the influence of individual differences in the tendency to use others for social comparison. As I demonstrated, learners' tendency to engage in social comparisons strongly influences learners' engagement and can partially lead to heightened learning outcome. I would expect individual differences, as assessed by social comparison orientation, to moderate the effects found in the aforementioned research as well. Thus, the BFLPE might not be true for people who are not prone to compare themselves with others. A starting point for future investigations of the BFLPE would be to assess social comparison motives and observe their unique influence on learners' academic self-concept for learners who are and those who are not predisposed to rely on social comparisons for self-evaluation.

The research discussed in Chapter 4 showed that habitual comparisons can suppress other strategic (social comparison) motives when choosing learning partners. As mentioned above, learners' social comparison tendencies are positively associated with various types of achievement goals (Bounoua et al., 2012; Darnon et al., 2010; Régner et al., 2007). Research on the link between the direction of social comparisons and achievement goals just recently caught researchers' interest. For example, Bounoua and colleagues (2012) found that the

pursuit of performance-avoidance goals facilitated downward comparisons whereas other achievement goals (performance-approach, mastery-approach, and mastery-avoidance) were connected to a preference for upward comparison targets. However, as discussed above, the influence of individual dispositions in choosing a comparison target may differ from their influence when choosing a learning partner. Thus, one can only speculate how the aforementioned interact when learners are given learning partner choices. There is evidence suggesting that social comparisons would override achievement goals. Van Yperen and Leander (2014) demonstrated that students relied more on social comparison information than on temporal comparison information associated with their achievement goal. The authors refer to this dominant reliance on social comparisons as "the overpowering effect of social comparison information" (TOESCI; Van Yperen & Leander, 2014, p.676). Thus, due to their findings and the habitual nature of social comparisons that I demonstrated, I would expect a learner's disposition to use others for comparison to also suppress achievement goals when choosing learning partners. However, the link to learning partner choices is missing in current research and thus should be addressed in future empirical investigations.

Practical implications

Taken together, social comparisons are likely to impact learners in collaborative learning in diverse ways. Assuming comparable effects in richer environments, this is clearly an influence teachers should be aware of when structuring and organizing collaborative learning settings. Collaboration is often structured through collaboration scripts and tools. Some collaboration tools, for example group puzzles as in the jigsaw classroom, depend on learners to share their unique knowledge (Aronson et al., 1978; Aronson & Patnoe, 1997). In the jigsaw classroom the lesson content is split into several parts and distributed among students. Students then have to collaborate and share their unique knowledge with their collaboration partners in order to establish a complete picture of the lesson (e.g. Aronson et al., 1978). If students then use others for social comparisons they might be hesitant in sharing and exchanging their knowledge; potentially leading to difficulties in collaboration and endanger the effectiveness of the jigsaw classroom. Thus, future research should clarify the influence of social comparisons in other environments and consequently provide guidelines for teachers on how to manage them in classroom settings.

Furthermore, knowledge hoarding can be detrimental for knowledge exchange in other environments, such as organizations. For example, for newcomers to be introduced into a new organization smoothly it would be necessary for senior coworkers to share knowledge about

common practices and rules. If senior workers then tend to use others for self-evaluation through social comparison they might not share the knowledge necessary for newcomers to be integrated into work processes quickly. This in turn might not only hinder newcomers from working effectively but also be detrimental to an organization's progress. Effective knowledge exchange can be crucial for an organization's success. Therefore, some organizations implement knowledge management systems to facilitate knowledge exchange between employees. However, even if a knowledge management system is in place workers might simply not enter their knowledge in order to manifest their expert status. Indeed, researchers noted that the usage of such systems is below expectations (Kimmerle, Wodzicki, & Cress, 2008; Matschke, Moskaliuk, & Cress, 2012; Matschke, Moskaliuk, Bokhorst, Schümmer, & Cress, 2014). Thus, part of employees' hesitation to provide knowledge in knowledge management systems might be due to social comparison processes. This assumptions is worth investigating in future research.

In any case, this dissertation demonstrated that attention to social comparison processes in learning and knowledge exchange is required, as they clearly influence how people collaborate.

Conclusion

In conclusion, social comparisons in collaborative learning present new unconsidered problems and opportunities for effective learning. When comparison options are constrained as often in CSCL, social comparisons are facilitated; leading to diverse outcomes for less and more knowledgeable learners. Furthermore, a learner's predisposition to use others for social comparisons can hinder strategic learning partner choices before collaboration starts and thus potentially harm learning. By applying social comparison theory to collaborative learning, the present dissertation contributes to a better understanding of the influence of social comparison tendencies on learners' engagement and preferences while learning with others. Furthermore, this work provides a promosing starting point for future combination of social and educational psychological research.

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Appendices

Appendix I: Learning material Studies 2.1-3.2

Appendix II: Social comparison orientation scale in German translation

Appendix III: Knowledge test Studies 2.2, 3.1, & 3.2

Appendix IV: Strategic social comparison motives scales Studies 4.1 & 4.2

Appendix I: Learning material Study 2.1-3.2

Einführungsteil: Instruktion zum individuellen Lernen

Bitte lesen Sie die Instruktion aufmerksam und vollständig durch!

Nun können Sie mit dem Lernen beginnen. Wie schon eingangs erwähnt, gibt es zwei Durchläufe - einen Einführungsteil und einen Hauptteil - mit jeweils den gleichen Aufgaben. Der Einführungsteil ist viel kürzer als der Hauptteil und soll Ihnen und Ihrem Partner ermöglichen, ein paar Grundbegriffe zu lernen und die Aufgaben des Experimentes kennen zu lernen.

Als Einstieg in das Thema wird zunächst individuell jeder für sich einen **Einführungstext zu den Komponenten des Immunsystems** lesen. Wir bitten Sie, den Text **vollständig und aufmerksam zu lesen und zu lernen**. Das ist wichtig, da die Grundbegriffe, die hier vermittelt werden, im weiteren Verlauf der Untersuchung noch oft vorkommen werden. Während des Lernens können Sie den Stift und den Zettel neben Ihrem Monitor benutzen, um einige zentrale Begriffe aufzuschreiben. Bedenken Sie beim Lernen jedoch, dass Sie Ihren Notizzettel vor dem abschließenden Wissenstest wieder abgeben müssen!

Nachdem Sie den Text gelesen und gelernt haben, sollen Sie für jeden Abschnitt angeben, **ob Sie ihn so gut verstanden haben, dass Sie ihn Ihrem Lernpartner erklären könnten**.

Für diese Aufgabe stehen Ihnen **2 Minuten** zur Verfügung.

Das Immunsystem

Aufgabe des Immunsystems

Die Aufgabe des Immunsystems besteht darin, den Organismus gegen eindringende Krankheitserreger(Pathogene) zu verteidigen. Wegen dieser globalen Funktion ist es nicht in einem bestimmten Organ lokalisiert, sondern wird im Blut realisiert, insbesondere durch verschiedene Gruppen von weißen Blutkörperchen (Leukozyten).

unspezifische Immunabwehr

Das Immunsystem umfasst zwei eng miteinander verknüpfte Formen der Abwehr:Das unspezifische Abwehrsystem reagiert generell auf Pathogene und bekämpft diese.Es wird eine Abwehrreaktion ausgelöst, die unabhängig von spezifischen Eigenschaften des Erregers ist. Die Abwehr von Pathogenen mittels unspezifischer Abwehr reicht für den Menschen nicht aus.

spezifische Immunabwehr

Deshalb verfügt der Körper außerdem über eine spezifische Abwehr. Dieses System reagiert angepasst an die Eigenschaften des jeweiligen Erregers. Das spezifische Abwehrsystem ist mit einer Gedächtnisfunktion ausgestattet, damit die Kenntnisse über den Erreger nach erfolgreicher Verteidigung erhalten bleiben. Dies ermöglicht bei erneutem Eindringen eine

schnelle Abwehrreaktion ohne erneute Erkrankung. Der Organismus ist dann immun gegen diesen Erreger.

zellulär-humorale Immunabwehr

Je nach den beteiligten Mechanismen werden die Abwehrsysteme in zelluläre und humorale Abwehr unterteilt. An zellulärer Abwehr sind spezialisierte Zellen beteiligt, während die humorale Abwehr an bestimmte Proteine des Blutplasmas gebunden ist.

Hauptteil: Instruktion zum individuellen Lernen

Bitte lesen Sie die Instruktion aufmerksam und vollständig durch!

Im Hauptteil werden Sie und Ihr Partner mehr über die Komponenten des Immunsystems lernen. Jeder lernt wieder zuerst individuell. Im Hauptteil lernen Sie aber nicht mit einem linearen Text, sondern mit **Hypertext**. Der Hypertext besteht aus **drei Seiten, die untereinander verlinkt sind, d.h. Sie müssen von einer Seite zur anderen Seite wechseln, indem Sie die Links anklicken.** Andernfalls können Sie nicht den ganzen Text lesen. Links werden unterstrichen dargestellt. Die Zahlen (1-3) am Anfang und am Ende jeder Seite dienen Ihnen als Navigationshilfe. Durch das Anklicken dieser Zahlen können Sie von einer Hypertext-Seite zur nächsten gelangen (und auch wieder zurück). Wir bitten Sie und Ihren Partner, die Inhalte des Hypertextes **vollständig und aufmerksam zu lesen und zu lernen. Ihr Ziel soll es sein, die Immunreaktion im menschlichen Organismus zu verstehen!** Auf diese Inhalte bezieht sich der Test am Ende der Studie.

Nachdem Sie den Text gelesen und gelernt haben, sollen Sie wieder für jeden Abschnitt angeben, ob Sie ihn so gut verstanden haben, dass Sie ihn Ihrem Lernpartner erklären könnten. Für diese Aufgabe stehen Ihnen **15 Minuten** zur Verfügung.

unspezifische Immunabwehr

Komplementfaktoren

Die unspezifische Abwehr wird von Faktoren des Komplementsystems und von Fresszellen getragen. Die etwa 30 Proteine des Komplementsystems wirken kaskadenartig zusammen. Sie binden sich an körperfremde (v.a. Bakterien) sowie körpereigene Strukturen. Körpereigene Strukturen wehren sich gegen eine Umlagerung mittels spezieller Proteine, die Komplement-Moleküle deaktivieren und sichern so die Selbsttoleranz.

Abwehr Komplement

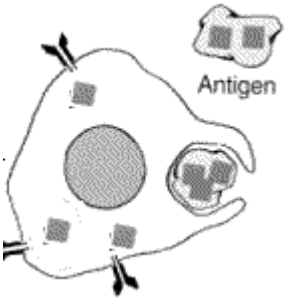
Zur Bekämpfung als körperfremd erkannter Proteine bedient sich das Komplementsystem hauptsächlich zweier Strategien: zum einen ist es in der Lage, Zellmembranen durch Zytolyse aufzulösen und damit die Zelle zu zerstören. Zum anderen schafft es die Voraussetzung für

Phagozytose, indem es sich an zu vernichtende Zellen anlagert und dadurch Fresszellen aktiviert.

Opsonisierung

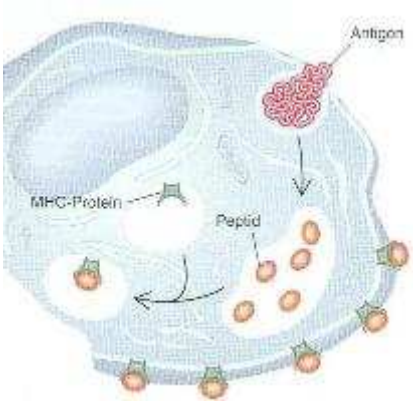
Diese Fresszellen werden auch Phagozyten genannt und gehören zu den weißen Blutzellen. Damit sie den Prozess der Phagozytose beginnen können, müssen Pathogene (oder abgestorbene Zellen) für die Fresszellen erkennbar gemacht werden. Dies geschieht durch den Mechanismus der Opsonisierung. Dabei lagern sich Faktoren des Komplementsystems oder Antikörper an das Antigen des Erregers an.

Phagozytose



Ein erkanntes Pathogen wird am Antigen über einen Rezeptor mit der Fresszelle verbunden. Daraufhin umhüllt die Fresszelle den Erreger, bis sie ihn vollständig umschließt. Schließlich nimmt sie ihn in sich auf. Durch Einwirkung von Phagolysosomen wird das Pathogen aufgelöst und abgebaut. Einige Bestandteile werden für die Fresszelle nutzbar gemacht, während die Reste ausgestoßen werden. Danach ist der Phagozyt zu einem neuen Einsatz bereit.

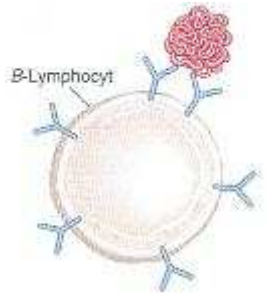
Antigenpräsentation Phagozyten



Phagozyten präsentieren auf ihrer Membran Teile des Antigens, einer spezifischen Eiweißstruktur, des Erregers, den sie zerstört haben. Präsentierende Zellen zerlegen in ihrem Zellinneren Antigene in Peptide, also in Teile von 8 bis 15 Aminosäuren. Diese werden mit Molekülen des MHC-II-Komplexes verbunden und auf der Zelloberfläche präsentiert. So wird die Erkennung spezifischer Peptid-MHC-Kombinationen durch T-Helferzellen ermöglicht.

spezifisch-humorale Immunabwehr

B-Lymphozyten-Aktivierung



Für die spezifische Abwehr durch Proteine sind Antikörper zuständig. Zur Produktion von Antikörpern werden B-Lymphozyten benötigt. B-Lymphozyten detektieren Antigene mit ihren Rezeptoren. Diese Rezeptoren sind spezielle Immunglobuline, die in der Membran der B-Zellen verankert sind. B-Lymphozyten werden aber erst durch die Bindung von Zytokinen, die von T-Lymphozyten abgegeben wurden, vollständig aktiviert.

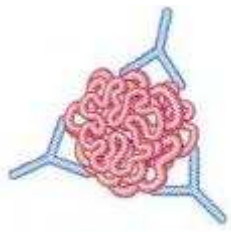
Antigenpräsentation B-Lymphozyten

Wurde der Antigen-Antikörper-Komplex erst einmal in die B-Zelle aufgenommen, so wird in deren Inneren das Antigen durch Enzyme in Peptide zerlegt. Diese werden von MHC-II-Proteinen gebunden und auf der Oberfläche der B-Zelle den T-Helferzellen präsentiert.

Antikörper-Produktion

Aktivierte B-Zellen teilen sich mehrfach. Die Mehrzahl der entstehenden Zellen sind Plasmazellen (ca. 500 je B-Lymphozyt), die Antikörper produzieren (je Plasmazelle ca. 2000 Antikörper pro Sekunde). Antikörper sind frei abgegebene lösliche Formen der B-Zell-Rezeptoren, also Immunglobuline.

Antikörper-Wirkung



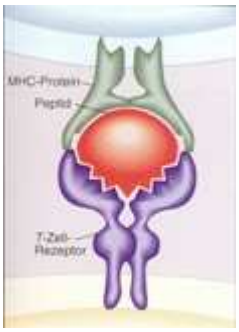
Die produzierten Antikörper besetzen Antigene, wobei Antikörper jeweils auf spezifische Antigene ausgerichtet sind. Erreger, deren Antigene von Antikörpern besetzt sind, werden durch Komponenten der unspezifischen Abwehr, also durch Phagozytose beziehungsweise Komplement, abgebaut.

B-Gedächtniszellen

Der Rest der Zellen geht in einen Ruhezustand über, speichert Informationen und stellt einen Teil des immunologischen Gedächtnisses (B-Gedächtniszellen) dar. Bei späteren Kontakten mit demselben Pathogen erfolgt die Produktion von Antikörpern schneller und stärker, da Antigene sofort erkannt werden.

spezifisch-zelluläre Immunabwehr

Peptiderkennung



Die zelluläre Immunantwort wird durch T-Lymphozyten getragen. T-Lymphozyten besitzen spezifische Rezeptoren, mit denen sie aber nicht wie Antikörper das ganze Antigen erkennen, sondern nur ein Peptid. Die Peptide müssen gemeinsam mit MHC präsentiert werden, wie es beispielsweise bei der Phagozytose erfolgt, damit sie für T-Lymphozyten detektierbar sind. T-Lymphozyten entdecken jeweils eine spezifische Peptid-MHC-Kombination. T-Lymphozyten docken daran an und beginnen dann, sich zu teilen.

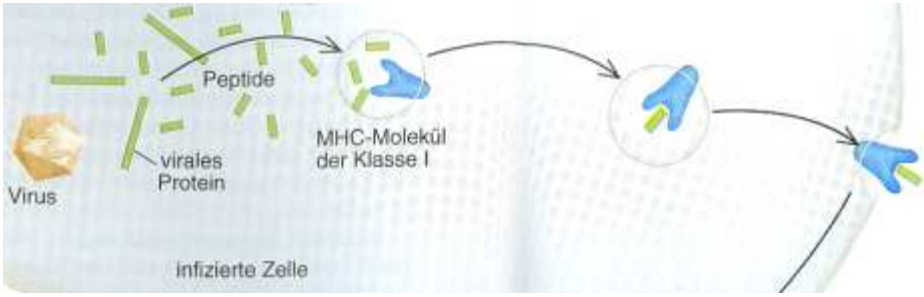
Spezialisierung

Bei der Teilung werden spezielle T-Zellen ausgebildet. Dazu gehören T-Helfer- und T-Killerzellen, welche nach Oberflächenmerkmalen unterschieden werden können. Durch Übergang eines Teiles der Helferzellen in eine Ruheform entstehen T-Gedächtniszellen, die bei erneutem Kontakt mit demselben Antigen umgehend die Produktion von speziellen T-Zellen veranlassen

T-Helferzellen

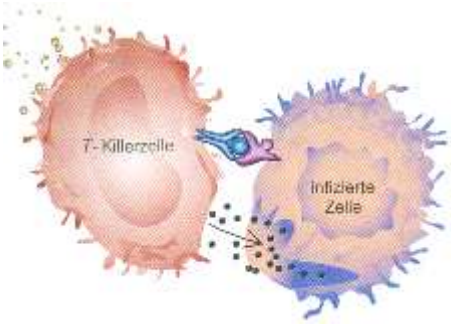
T-Helferzellen reagieren auf Peptid-MHC-Kombinationen von präsentierenden Zellen des Abwehrsystems. Für die Erkennung von Erregern durch T-Helferzellen werden die Peptide mit MHC-Molekülen der Klasse II präsentiert. Aktivierte T-Helferzellen geben Zytokine ab, welche sowohl von anderen T-Lymphozyten als auch von B-Lymphozyten gebunden werden.

T-Killerzellen-Aktivierung



T-Killerzellen detektieren solche Peptid-MHC-Kombinationen, bei denen die Peptide in der präsentierenden Zelle selbst entstanden sind. Für die Erkennung von Erregern durch T-Killerzellen werden die Peptide mit MHC-Molekülen der Klasse I präsentiert. T-Killerzellen sind notwendig, weil Pathogene mit verschiedenen Strategien versuchen, sich zu schützen (zum Beispiel verändern Viren ihre Oberflächen durch Mutationen oder sie dringen möglichst schnell in Wirtszellen ein). Wenn T-Killerzellen einen Erreger detektieren, werden sie dadurch teilweise aktiviert. Erst durch die von den T-Helferzellen abgegebenen Zytokine werden die T-Killerzellen dazu veranlasst, sich zu vollständig aktivierten T-Killer-Zellen auszudifferenzieren

Abwehr T-Killerzellen



Daraufhin töten T-Killerzellen die infizierte Zelle ab. Mittels spezieller Proteine, den Perforinen, kann die Membran attackiert werden. Ist die Zellwand erst einmal durchlöchert, dringen so genannte Granzyme ein und aktivieren dort mehrere Enzyme, welche die Zelle Stück für Stück verdauen.

Appendix II: Social comparison orientation scale

Jeder von uns stellt von Zeit zu Zeit Vergleiche mit anderen Menschen an. Man vergleicht zum Beispiel wie man sich fühlt und welche Meinungen oder Fähigkeiten man hat. Oder man vergleicht eine Situation, in der man sich befindet, mit der Situation von anderen Menschen. Manche Menschen stellen diese Vergleiche öfter an, andere tun es eher seltener. In diesem Fragebogen geht es darum, wie das bei Ihnen ist. Kreuzen Sie bitte an, in wie weit die folgenden Aussagen für Sie persönlich zutreffen.

- Oft vergleiche ich die Situation von Menschen, die mir nahe stehen, mit der von anderen Menschen.
- Ich achte immer sehr darauf, wie ich Dinge im Vergleich zu anderen erledige.
- Wenn ich herausfinden möchte, wie gut ich etwas gemacht habe, dann vergleiche ich meine Leistung mit der von anderen Menschen.
- Ich vergleiche häufig meinen sozialen Status (z.B. soziale Fähigkeiten, Beliebtheit) mit dem von meinen Mitmenschen.
- Ich bin nicht der Typ Mensch, der sich häufig mit anderen vergleicht. (R)
- Wenn ich daran denke, was ich bis jetzt im Leben erreicht habe, vergleiche ich mich häufig mit anderen Menschen.
- Ich unterhalte mich gerne mit anderen Menschen über gemeinsame Erfahrungen und Meinungen.
- Oft versuche ich herauszufinden, was andere Leute denken, die ähnliche Probleme haben wie ich.
- Es interessiert mich oft, was andere Leute in einer ähnlichen Situation wie meiner machen würden.
- Wenn ich mehr über eine Sache erfahren möchte, dann versuche ich herauszufinden, was andere darüber denken.
- Nie betrachte ich meine Lebenslage in Bezug auf andere.(R)

R= reversed coded, scale range from -3 to +3 (ich stimme überhaupt nicht zu, ich stimme nicht zu, ich stimme eher nicht zu, neutral, ich stimme einigermaßen zu, ich stimme zu, ich stimme voll und ganz zu)

Appendix III: Knowledge Test Studies 2.2, 3.1, & 3.2

Pro Satzanfang werden Dir vier Möglichkeiten angeboten, wie die Aussage weitergehen könnte. Unter diesen vier Alternativen können 0,1,2,3 oder 4 richtige Aussagen sein. In den Fällen, wo keine der Aussagen richtig ist, wähle bitte die Option ″Keine der Antworten ist richtig.″. Ansonsten wählst Du bei jeder Frage alle richtigen Antworten aus.

1) Die zum Komplementsystem gehörenden Proteine…

X binden sich an körperfremde Strukturen.

X lagern sich an körpereigene Strukturen an.

… werden aus ihrer Bindung körperfremder Strukturen wieder gelöst.

… werden aus ihrer Bindung körpereigener Strukturen wieder gelöst.

Keine der Antworten ist richtig.

2) B‐Lymphozyten werden aktiviert durch…

… die Detektion spezifischer Peptid‐MHC‐Kombinationen.

X die Bindung von Zytokinen an der B‐Zelle.

… das Andocken von Antigenen des Pathogens am B‐Zell‐Rezeptor.

… die Opsonisierung von Komplementfaktoren am Pathogen.

Keine der Antworten ist richtig.

3) Die Detektion von Pathogenen durch T‐Lymphozyten…

X erfolgt über Peptide auf präsentierenden Zellen.

X setzt die Verbindung mit MHC voraus.

X führt zur Bindung des T‐Lymphozyten an das Pathogen.

X führt zur Teilung des T‐Lymphozyten.

Keine der Antworten ist richtig.

4) An der Bekämpfung von Pathogenen wirken Komplementfaktoren mit, indem sie Pathogene…

… durch Antigen‐Präsentation für T‐Lymphozyten erkennbar machen.

… für Antikörper erkennbar machen.

X für Phagozyten erkennbar machen.

X direkt zerstören.

Keine der Antworten ist richtig.

5) Die Antigen‐Präsentation der B‐Lymphozyten…

… wird von anderen B‐Lymphozyten erkannt.

… ermöglicht deren Detektion durch T‐Lymphozyten.

X setzt die Bindung des Antigens am Rezeptor voraus.

X setzt die Aufnahme des Antigens in die B‐Zelle voraus.

Keine der Antworten ist richtig.

6) T‐Lymphozyten differenzieren sich bei der Teilung…

X in strukturell unterschiedliche Arten von T‐Zellen.

X in funktional unterschieldiche Arten von T‐Zellen.

… damit sie schwerer für Pathogene erkennbar sind.

X und bilden aktive und ruhende Zellen.

Keine der Antworten ist richtig.

7) Fresszellen erkennen Pathogene, …

X die von Faktoren des Komplementsystems markiert wurden.

… die von Peptid‐MHC‐Kombinationen markiert wurden.

X die von Antikörpern markiert wurden.

… die von Zytokinen markiert wurden.

Keine der Antworten ist richtig.

8) Antikörper…

… bestehen aus festen Verbindungen mehrerer B‐Zell‐Rezeptoren.

X werden gebildet, nachdem B‐Zellen sich geteilt haben.

… sind ein Recyclingprodukt beim Abbau alternder B‐Zellen.

… werden von aktivierten B‐Zellen produziert.

Keine der Antworten ist richtig.

9

T‐Helferzellen reagieren auf Peptide von Pathogenen…

X die von virus‐infizierten Körperzellen zusammen mit MHC‐II Molekülen präsentiert werden.

… die von Phagozyten zusammen mit MHC - I Molekülen präsentiert werden.

… mit der Ausschüttung von Perforinen.

… mit der Zerstörung des Pathogens.

Keine der Antworten ist richtig.

10) Beim Prozess der Phagozytose…

X docken Phagozyten am Antigen des Pathogens an.

X umschließen Phagozyten das Pathogen vollständig.

… attackieren Phagozyten die Zellmembran des Pathogens mittels Perforinen.

… werden die Zellbestandteile des Pathogens durch Granzyme verdaut.

Keine der Antworten ist richtig.

11) Wenn Antikörper Antigene des Pathogens besetzen, dann…

… bauen T - Helferzellen das Pathogen ab.

X bauen Phagozyten das Pathogen ab.

… bauen T - Killerzellen das Pathogen ab.

X bauen Komplementfaktoren das Pathogen ab.

Keine der Antworten ist richtig.

12) T - Killerzellen reagieren auf Peptide von Pathogenen…

… die zuvor von der präsentierenden Zelle detektiert wurden.

… die zuvor von der präsentierenden Zelle zerstört wurden.

… die zuvor in die präsentierende Zelle eingedrungen sind.

… die zuvor von der präsentierenden Zelle markiert wurden.

X Keine der Antworten ist richtig.

13) Bei der Antigen - Präsentation der Phagozyten…

X werden Antigene in Peptide zerlegt.

… werden weitere Phagozyten mobilisiert.

… geben Phagozyten freie MHC - Komplexe ab.

X wird eine Detektion von Pathogenen durch T - Lymphozyten ermöglicht.

Keine der Antworten ist richtig.

14) B‑Gedächtniszellen tragen zur Immunisierung bei, indem…

X sie Informationen über spezifische Antigene speichern.

… sie kontinuierlich auf spezifische Antigene ausgerichtete Antikörper produzieren.

… sie bei erneutem Kontakt sofort Zytokine ausschütten.

… sie bei erneutem Kontakt direkt Phagozyten aktivieren.

Keine der Antworten ist richtig.

15) T‑Killerzellen wehren Pathogene ab, …

… indem sie sie teilungsunfähig machen.

… indem sie das Pathogen vollständig umschließen.

… indem sie sie zur Mutation anregen.

X indem sie das Pathogen durch Enzyme verdauen.

Keine der Antworten ist richtig.

Appendix IV: Strategic social comparison motives scales Studies 4.1 & 4.2

Wahrscheinlich haben Sie sich schon einmal mit einer anderen Person verglichen. Bitte geben Sie für die unten aufgeführten Gründe an, inwiefern dies auch für Sie Gründe waren, sich zu vergleichen.

"Wenn ich mich mit jemand anderem vergleiche, dann mache ich das...
... um meine eigenen Fähigkeiten zu beurteilen."
... um zu sehen, wie gut ich bin."
... um Einblick in meine Fähigkeiten zu gewinnen."
... um zu sehen, ob ich schnell genug lerne."
... um besser zu werden."
... um mir ein Ziel zu setzen."
... um meine Fähigkeiten zu verbessern."
... um andere als Vorbild zu nehmen."
... um mich besser zu fühlen."
... um mir sicherer darüber zu sein, wie gut ich bin."
... um mich gut in Bezug auf meine eigene Situation zu fühlen."

Summary

Collaborative learning has received increasing attention in all levels of education (Johnson et al., 2007; Webb & Mastergeorge, 2003). Under the right circumstances, learners can achieve higher knowledge levels and better learning outcomes in collaboration than individual learners (e.g. Dillenbourg et al., 1996; Garrison et al., 2001; Johnson & Johnson, 1999). The nature of collaborative learning is in itself to work *with* another person. Thus, collaborative learning carries with it the potential for social comparisons (Festinger, 1954). Therefore, it comes to no surprise that social comparisons are strongly facilitated when learning with others (Dijkstra et al., 2008). Structured collaboration as in computer-supported collaborative learning (CSCL) with knowledge awareness is often used to heighten the efficiency of collaborative learning settings (Dillenbourg et al., 1996) but might also introduce the aforementioned comparisons more strongly than traditional collaboration. How this in turn influences learners' engagement and learning is unclear and understudied.

Furthermore, for the duration of collaboration in CSCL learners' comparison options are often constrained. However, before collaboration, learners might be free to seek learning partners according to their individual needs and motivations. Generally, having a choice in their learning partner provides learners with a sense of control over their situation as well as motivates students to engage in learning (Pintrich, 2003). Therefore, giving learners a choice might be beneficial for collaborative learning. However, this choice might also encourage social comparisons with potential learning partners. Based on this assumption, this dissertation examines if social comparison already influence learning partner choices before collaboration.

How social comparisons facilitated by CSCL settings influence a learner's behavior and engagement and if comparisons influence learning partner choices likewise is core to this dissertation. This was addressed in a set of empirical studies. The findings indicate that social comparisons facilitated by knowledge awareness in CSCL can lead to knowledge hoarding and lowered learning outcomes for more knowledgeable learners. In contrast, for less knowledgeable learners social comparisons facilitated by knowledge awareness can lead to heightened engagement and learning outcome. Furthermore, social comparisons also influence learners before actual collaboration: social comparisons can hinder strategic learning partner choices and thus potentially harm learning.

By applying social comparison theory to collaborative learning, the present dissertation contributes to a better understanding of the influence of social comparison tendencies on learners' engagement and preferences while learning with others. Furthermore, this work provides a comprising starting point for future combination of social and educational psychological research.

Deutsche Zusammenfassung

Kollaboratives Lernen findet vielseitigen Einsatz auf allen Bildungsebenen (Johnson et al., 2007; Webb & Mastergeorge, 2003). Unter idealen Umständen können Lernende sowohl einen höheren Wissenstand als auch bessere Lernergebnisse erzielen als individuell Lernende (e.g. Dillenbourg et al., 1996; Garrison et al., 2001; Johnson & Johnson, 1999). Dabei bedeutet zu kollaborieren immer *mit* einer anderen Person zusammen zu arbeiten. Somit eröffnet kollaboratives Lernen auch die Möglichkeit für soziale Vergleiche (Festinger, 1954). Daher ist es nicht überraschend, dass soziale Vergleiche durch das Lernen mit anderen oft auch erst hervorgerufen werden (Dijkstra et al., 2008). Computer-gestützte kollaborative Lernumgebungen, die den Wissenstand der Lernpartner verdeutlichen, werden häufig genutzt um die Effektivität des kollaborativen Lernens zu erhöhen (Dillenbourg et al., 1996). Allerdings kann das Bewusstsein über den Wissenstand eines Lernpartners soziale Vergleiche umso stärker nahelegen. Wie sich diese Vergleiche dann auf die Bemühungen und das Lernen der Kollaborateure auswirkt ist unklar und wurde bisher nicht untersucht.

Des Weiteren sind die Vergleichsoptionen während der Kollaboration in computer-gestützten kollaborativen Lernumgebungen beschränkt auf den derzeitigen Lernpartner. Möglicherweise könnten sich Lernende jedoch vor der Kollaboration Lernpartner, die zu ihrem individuellen Bedürfnissen und ihrer Motivation passen, aussuchen. Wenn Lernende sich selbst einen Lernpartner aussuchen dürfen, erleben sie ein Gefühl der Kontrolle über ihre eigene Situation und sind motivierter sich beim Lernen anzustrengen (Pintrich, 2003). Daher könnte es die Effektivität kollaborativen Lernens fördern, wenn man Lernenden die Wahl ihres Lernpartners überlässt. Diese Wahlmöglichkeit könnte allerdings zugleich auch zu sozialen Vergleichen mit den potentiellen Lernpartnern führen. Ausgehend von dieser Erwartung untersucht die vorliegende Arbeit zudem ob soziale Vergleiche bereits die Lernpartnerauswahl vor der Kollaboration beeinflusst.

Kern dieser Dissertation ist es, herauszufinden, inwiefern soziale Vergleiche, die durch computer-gestützte kollaborative Lernumgebungen hervorgerufen werden, die Bemühungen und das Lernen von Kollaborateuren sowie die Lernpartnerauswahl beeinflussen. Dieser Frage wurde in mehreren empirischen Studien nachgegangen. Die Ergebnisse zeigen, dass das Bewusstsein über den Wissenstands eines Lernpartners soziale Vergleiche hervorruft, die bei Lernenden mit mehr Wissen als ihr Lernpartner zur Verringerung der Wissensweitergabe und geringeren Lerneffekten führen können. Im Gegensatz dazu können soziale Vergleiche bei Lernenden mit weniger Wissen als ihr Lernpartner zu erhöhter Anstrengung und höheren Lerneffekten führen. Des Weiteren zeigte sich, dass soziale Vergleiche bereits die

Lernpartnerauswahl vor der Kollaboration beeinflussen: Soziale Vergleiche führen dazu, dass Lernende keine strategische Lernpartnerauswahl treffen. Dies wiederum könnte den späteren Lernerfolg negativ beeinflussen.

Die vorliegende Arbeit verbindet die Theorie sozialer Vergleiche mit kollaborativem Lernen und trägt zu unserem Verständnis bei, wie soziale Vergleiche die Anstrengung Lernender sowie deren Lernpartnerauswahl beeinflussen. Somit liefern die berichteten Erkenntnisse Anknüpfungspunkte für zukünftige Forschung zwischen Sozialpsychologie und Pädagogischer Psychologie.

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Comparison is the thief of joy.

- Theodore Roosevelt

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