Psychological safety and social support in groupware adoption: A multi-level assessment in education

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Abstract

In this paper, the authors propose that psychological safety, a sense of interpersonal trust and being valued in a work team, is an important determinant of groupware technology adoption in an educational setting. They develop and test a model of antecedents and consequences of psychological safety. Data were collected from 361 university students, organized in 36 teams. Results of multi-level regression analysis reveal positive individual-level effects of perceived tutor support and perceived peer support on psychological safety. Furthermore, our findings show a positive unique group-level effect of perceived tutor support on psychological safety, where an individual’s level of self-consciousness strengthens this positive impact. In addition, findings of structural equation modeling demonstrate that both perceived usefulness and perceived ease of use partially mediate the positive effect of psychological safety on groupware usage. Psychological safety also shows a positive direct effect on groupware usage. Finally, a student’s offline communication frequency with his tutor and peers appears to strengthen the impact of psychological safety on perceived usefulness, perceived ease of use, and groupware usage.

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1. Introduction

A growing variety of organizations implement groupware technologies to improve collaboration in their group-based organization structures (Chen & Lou, 2002). Groupware technologies “provide electronic networks that support communication, coordination, and collaboration through facilities such as information..."
exchange, shared repositories, discussion forums, and messaging” (Orlikowski & Hofman, 1997, p. 12). One major benefit of groupware is that it helps team members to overcome geographical and time constraints when interacting/communicating with each other (Benbunan-Fich, Hiltz, & Turoff, 2002). In education, e-learning systems and virtual learning environments enable improvements in communication efficiency between student and teacher, as well as among students working in groups (Martins & Kellermanns, 2004). These technologies also allow competence-based learning in flexible co-operative groupings and can result in qualitatively more supportive and productive learning processes (Mooij, 2004).

Despite the potential benefits, many groupware technologies are underutilized or abandoned completely (De Vreede, Davison, & Briggs, 2003; Fjermestad, 2004). Evidence in literature suggests that (the lack of) interpersonal trust may be a key factor in groupware adoption. For instance, Kelly and Jones (2001) argue that personal bonds, established relationships, and social contacts are of utmost importance for successful implementation of groupware technology in a financial service company. Similarly, Brown, Poole, and Rodgers (2004) state that medical practitioners’ resistance to telemedicine can be overcome by establishing trusting relationships between involved parties. Groupware induces a certain degree of virtuality, which reduces the number of tacit clues for an individual to estimate the risk of exploitative behavior by the others. Additionally, introducing technology in an educational environment can dramatically change both teachers’ and students’ roles (Mooij & Smeets, 2001). This forces individuals to increasingly rely on each other, while being subject to others’ potential social loafing, flaming attempts (i.e. posting hostile or insulting digital messages using the system), or other undesired actions and consequences. Therefore, additional time and effort must be spent monitoring colleagues or fellow students, backing up or duplicating each others’ work, and documenting problems (Wilson, Straus, & McEvily, 2006). This leads to extra costs and decreased work effectiveness and productivity (McAllister, 1995). As a result, collaboration using computer-mediated technologies can only be effective if all parties are willing to open themselves to one another in order to jointly carry out a task, solve problems, and learn (Jarvenpaa, Knoll, & Leidner, 1998).

So far, researchers have focused much of their attention on outcome criteria of groupware systems (Eden & Ackermann, 1996), such as participation (Dennis & Garfield, 2003), efficiency (Dennis, Hayes, & Daniels, 1999), knowledge transfer (Chen & Shaw, 2006) and learning effects (Rada, 1998; Veen, Lam, & Taconis, 1998). Despite the role social–psychological factors (e.g. interpersonal trust, social support, level of communication) play in achieving these outcomes, they have been largely ignored in explaining groupware adoption (Dennis & Reinecke, 2004). This study addresses this research gap in an educational setting, making the following contributions to literature.

First, we enrich the existing scope of groupware adoption in an educational setting by incorporating trust-based student-team dynamics into our study, proposing psychological safety to be an important determinant of groupware adoption. Psychological safety can be defined as the feeling of a student that he is able to show and employ himself in his tasks without fear of negative consequences to self-image, social status or school career (cf. Kahn, 1990). Where interpersonal trust typically reflects mutual confidence (Jones & George, 1998), psychological safety is a broader construct that also encompasses a sense of being valued and comfortable in that setting. The concept has been introduced in organizational learning literature relatively recently, and has predominantly been assessed in a medical context (Edmondson, 2003; Edmondson, Bohmer, & Pisano, 2001; Lee, Edmondson, Thomke, & Worline, 2004; Nemhard & Edmondson, 2006; Tucker, Nemhard, & Edmondson, 2007; Wilkens & London, 2006). However, psychological safety has also displayed positive effects in business settings, enhancing employee engagement at work (May, Gilson, & Harter, 2004), team learning behavior (Carmeli, 2007; Edmondson, 1999), and firm performance (Baer & Frese, 2003). Despite the fact that psychological safety may be critical in a groupware supported student team, where social loafing, flaming, and/or bullying might occur, its role has not yet been empirically substantiated in an educational setting. Additionally, in studies on e-learning adoption, the focus has primarily been on system characteristics and individual traits (Chiu, Hsu, Sun, Lin, & Sun, 2005; Pituch & Lee, 2006; van Raaij & Schepers, 2008), while interpersonal and group processes have not received much research attention. Our study addresses this research gap.

Second, previous literature offers little guidance on the impact of different types of determinants of psychological safety in groupware adoption. Past studies have demonstrated that social support is of key importance in situations that are characterized by a lack of tacit cues (Wiesenfeld, Raghuram, & Garud, 2001). So far,
however, the impact of supportive conditions on individuals’ safety perceptions has been left virtually unexplored. Therefore, we will focus on the impact of social support on psychological safety, using perceived organizational support theory (Eisenberger, Huntington, Hutchison, & Sowa, 1986; Rhoades & Eisenberger, 2002). In our educational context, this theory would predict that students perceiving high social support are in a better study mood and suffer fewer strain symptoms, i.e. feel safer. In addition, education has been classified as a multi-level system where characteristics between different levels (individual, small group, class, etc.) may interact over the course of time, yielding a complex picture of effects which can influence learning processes and outcomes (Mooij, 2004). Especially the use of groupware implies that students work in teams. As the students work together, individual perceptions on the level of support are likely to converge, so that each team develops its own typical shared view on support (Kozlowski & Klein, 2000). Hence, besides individual differences on support perceptions, also differences between teams are likely to arise (Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000). Consequently, recent research has shown a growing interest in the question of whether typical individual-level findings are representative of corresponding higher-level relationships (Dineen, Noe, Shaw, Duffy, & Wiethoff, 2007). We therefore examine whether group-level (i.e. aggregated) perceptions of social support explain incremental variance in students’ individual assessments of psychological safety.

Third, there has been an important tradition of studying person–situation interactions in psychology (Endler & Magnusson, 1976), which has also been established for understanding support judgments (Lakey, McCabe, Fisicaro, & Drew, 1996). Organizational behavior literature has indicated that the impact of supportive conditions on individual’s work-related perceptions typically depends on individual traits. For instance, Colbert, Mount, Harter, Witt, and Barrick (2004) report that the relationships between perceived social support and interpersonal workplace deviance is moderated by agreeableness. In this study we test whether the relationship between support and psychological safety is moderated by the individual trait of self-consciousness.

Fourth, studies have suggested that groupware is most efficient when used as supplementing, and not a supplanting mode of contact for teams involved (Benbunan-Fich et al., 2002; Dennis & Reinecke, 2004; Kelly & Jones, 2001). Hence, the amount of offline communication supporting the online processes could be an important precondition for successful groupware adoption. While the moderating impact of communication frequency has been extensively investigated in social sciences (Becerra & Gupta, 2003; Kacmar, Witt, Zivnuska, & Gully, 2003), it has hardly received attention in the context of IT adoption relationships. We therefore test the moderating role of offline communication frequency in our framework.

To address these issues, we structure our article as follows. We begin with a literature overview of psychological safety. Next, we build our conceptual model. In addition, we empirically test the specified hypotheses, and discuss the results. We end up with future research directions and limitations of the study.

2. Literature review

Safety beliefs are rooted in Maslow’s (1943) classical work, describing human behavior to be motivated by a set of five goals (i.e. basic needs) arranged in a hierarchy of prepotency. After satisfying one’s primary need of hunger and thirst (or the possibility to do so), an individual strives to be protected against physical and mental threats. Parents and the normal family setup are indisputable mechanisms for supplying love and care in this respect. Reflecting Maslow’s thoughts on the current everyday practice in organizations, employees need a safe work environment in order to be able to motivate themselves to strive for higher order goals.

Physically safe and healthy work conditions have received some attention in organizational behavior literature. For example, Zohar (2000) empirically shows that when an individual perceives a climate to be more safe, this reduces the injury rate within an organizational subunit. However, mental safety (i.e. psychological safety) is a relatively new concept which has received research attention only very recently (May et al., 2004). An individual experiences psychological safety when he/she feels able to show and employ himself/herself without fear of negative consequences to self-image, status or career (Kahn, 1990). People feel mentally safe in an organization if speaking up to colleagues or fellow students will not lead to personal harm or rejection. This should hold true for all types of discussions, ranging from a personal conversation to addressing flaws in work processes.
Edmondson (2004) argues that individuals perform tacit calculus at micro-behavioral decision points, assessing the interpersonal risk of a certain behavior in a specific situation. They ask themselves the question whether they will be criticized or embarrassed if they perform behavior X in situation Y. Since the behavior of people in an individual's environment plays an important role in making this decision, the concept of psychological safety is closely related to the construct of interpersonal trust. Both constructs describe the willingness or likeliness of vulnerability to others' actions, but psychological safety goes beyond interpersonal trust (Edmondson, 2004), since it also encompasses a sense of being valued and comfortable in that setting. This can be of utmost importance in using a groupware system, since less face-to-face contact simplifies displaying opportunistic behavior for team members. Not contributing equally to the group’s processes (social loafing) or posting insulting messages (flaming) can also occur (Alonzo & Aiken, 2004). Research has shown that conflicts easier arise and escalate using digital forms of communication compared to face-to-face communication (Friedman & Currall, 2003). Feeling safe in one's work or study environment and being valued by team members can diminish this polarization.

Psychological safety can be regarded as a psychological climate: a property of individuals denoting their perception of the psychological impact that the work or study environment has on his or her personal well-being (James & James, 1989; Schneider & Reichers, 1983). Proponents of psychological climate theory posit that individuals respond primarily to cognitive representations of environments “rather than to the environments per se” (James & Sells, 1981). Each individual constitutes his or her own psychological climate of the same environment. Perceptions may nevertheless differ based on personal belief systems and individual biases. We therefore consider psychological safety to operate on the individual-level.

3. Research model and hypotheses

In this section, we use perceived organizational support theory (Eisenberger et al., 1986; Rhoades & Eisenberger, 2002) to discuss those supportive organizational conditions that serve as antecedents of psychological safety. Perceived organizational support theory is often applied in organizational behavior literature (Rhoades & Eisenberger, 2002), and states that to meet socio-emotional needs (e.g. feeling safe), employees develop global beliefs concerning the extent to which the organization values their contributions and cares about their well-being (Eisenberger et al., 1986). Individuals who perceive the organizational support to be high find their job more pleasurable, are in a better mood performing their tasks, and suffer fewer strain symptoms like anxiety (Rhoades & Eisenberger, 2002).

Perceived organizational support theory distinguishes two major types of organizational support variables: perceived supervisor support and perceived peer support (cf. Eisenberger, Stinglhamber, Vandenberghe, Sucharski, & Rhoades, 2002). A supportive context basically entails three major aspects: rewards, coaching, and information (De Jong, De Ruyter, & Wetzels, 2005). Obviously, these aspects carry a different content in an educational setting compared to a business setting. Where rewards are oftentimes monetary in business, students mainly get rewards from fellow students’ appreciation or from obtaining higher grades. Where coaching and information can take on the form of meetings discussing personal progress in companies, students obtain personal or class feedback from tutors (as the equivalent of supervisors) and fellow students. Hence, in an educational setting, support can be received either from a student’s tutor or from peers.

Edmondson (2004) argues that if a leader is accessible and approachable for subordinates, people feel more comfortable in their work environment. Furthermore, when interpersonal relationships in someone’s work environment are supportive, open, and respectful, they have a major impact on feelings of safety (Edmondson, 2004; May et al., 2004). This holds especially true for relationships across different hierarchical echelons, since these are traditionally regarded as more stifling and threatening than relationships with peers (Kahn, 1990). May et al. (2004) also empirically show peer relations and supervisor relations to positively influence psychological safety. Translating these findings into an educational context, we would expect that supportive inter-student relationships as well as supportive tutor–student relationships affect psychological safety. Hence, we state:

\[ H1: \] Perceived tutor support positively influences a student’s assessment of his psychological safety.

\[ H2: \] Perceived peer support positively influences a student’s assessment of his psychological safety.
3.1. Group-level effects

With education typically being a multi-level system, technology can help to design, integrate, record, and regulate instructional and learning processes across different organizational levels (Mooij, 2004). While students can use groupware individually, for instance to download lecture slides, the technology also supports team communication and cooperation. Since a student team jointly uses the groupware to collaborate, members of the team influence each other in their perceptions towards the technology and their study environment in general. While these perceptions may be divergent upon starting a project, interpersonal processes and social dynamics cause individual beliefs to converge, resulting in a shared team view (Kozlowski & Klein, 2000). As such, researchers have proposed that individual team-member perceptions can meaningfully be aggregated to a team level of analysis (Chen & Bliese, 2002; Mathieu et al., 2000). These aggregate-level constructs represent synergetic, social processes of individuals within teams that are not captured by their individual-level equivalents and might therefore have a differential impact on psychological safety perceptions.

When students in a group study and learn together, communicate, and give feedback, they integrate their opinions, constituting a shared perception of their supportive conditions of their study environment (cf. Mathieu et al., 2000). For instance, while an individual student may think that social support is relatively low, other team members can have a different opinion. As such, students influence each other to construct joint opinions on the level of social support. The student with initial negative perceptions may slightly adjust them to be more consistent with the group’s view, but the shared group perception will still differ from individualized opinions. Since social dynamics among group members converge individual perceptions, and support from supervisors and tutors is often directed at the group instead of the individual (Chen & Bliese, 2002), it is meaningful to discriminate between individual-level influences and group-level influences of social support on psychological safety. Consequently, we adopt an approach that analyses the influence of predictor variables at two levels.

Following the majority of studies, our group-level operationalization of antecedents is based on the direct consensus model, where the group-level variables reflect aggregates of the individual scores (cf. De Jong, De Ruyter, & Lemmink, 2004). This entails that the relationship between the antecedents and psychological safety is primarily hypothesized at the individual-level. However, additional hypotheses H3a and H3b are included to examine whether the group-level aggregates yield additional, differential, effects to the explanation of psychological safety. Therefore, we hypothesize that:

H3a: At the group-level of analysis there will be a positive effect of perceived tutor support that accounts for a significant amount of additional variance in psychological safety.

H3b: At the group-level of analysis there will be a positive effect of perceived peer support that accounts for a significant amount of additional variance in psychological safety.

3.2. The moderating role of self-consciousness

In organizational behavior literature, individual traits are frequently considered as moderators of relationships including psychosocial variables, as they adequately capture the variation in employee differences (Dabholkar & Bagozzi, 2002). These traits may serve as discretionary stimuli that differentially influence individuals’ perceptions of team social processes, producing systematic variation in its ratings (Hackman, 1992). As we expect a differential impact of group-level predictors of social support on psychological safety above individual-level predictors, we are interested whether these synergetic effects hold for different types of students. We propose that in an educational setting, the individual trait of self-consciousness moderates the relationship between the support variables and psychological safety. Self-consciousness can be defined as “a person’s view of himself or herself as a social object, with an acute awareness of other people’s perspectives about him or her” (Dabholkar & Bagozzi, 2002, p. 189). This trait typically comes into play in situations which are characterized by social risk (May et al., 2004), since exposure to opportunistic actions of others may considerably lower feelings of interpersonal trust. In a study environment, self-consciousness could be particularly relevant, since being bullied or becoming an outcast can seriously affect current study results, future
productivity as a company employee, and even the tendency towards displaying delinquent behavior (Harvey, Heames, Richey, & Leonard, 2006; Veenstra et al., 2005).

Students who feel highly self-conscious are afraid to be judged as different, and are therefore engaged by the work of managing impressions (Kahn, 1990). Adhering to shared perceptions is a vehicle for doing so. As a consequence, students who feel self-conscious about using groupware technologies might be more inclined to consider shared opinions about support from their tutors and their peers in their assessments of psychological safety. In contrast, team members who score low on self-consciousness care less about adhering to shared opinions since they do not fear being watched and judged in their personal routine. Therefore, we hypothesize:

\[ H4a: \text{At the group-level of analysis, the positive effect of perceived tutor support on psychological safety will be stronger for students with a higher self-consciousness.} \]

\[ H4b: \text{At the group-level of analysis, the positive effect of perceived peer support on psychological safety will be stronger for students with a higher self-consciousness.} \]

3.3. Outcomes of psychological safety

Existing studies have associated psychological safety with team learning behavior and team performance (Edmondson, 1999), firm goal achievement and return on assets (Baer & Frese, 2003), personal engagement at work and job involvement (Brown & Leigh, 1996; Kahn, 1990; May et al., 2004), and face giving (Tynan, 2005). Edmondson et al. (2001) show psychological safety to play a critical role in the successful adoption of a new surgery technique in hospitals by members of ER teams. Teams characterized by a higher degree of psychological safety displayed more effective and satisfactory use of the new technology, compared to teams where people did not feel safe. Furthermore, Edmondson and Woolley (2003) demonstrate that psychological safety has a positive impact on the acceptance of an organization-wide change program in a large manufacturing company. These findings imply that psychological safety reduces defensiveness and “learning anxiety” in uncertain and unknown situations (Schein, 2004).

Particularly the introduction of groupware is an example of an uncertain situation, as it relates to the shift to new communication structures and document exchanges (Mooij & Smeets, 2001). This gives new users the opportunity for misusing the system for flaming or social loafing. However, if students feel valued by their peers and are comfortable in their environment, the risk of opportunistic behavior will be judged as minimal and they do not have trouble speaking up in case of difficulties or problems. Consequently, more positive perceptions towards the groupware technology will be sparked.

Traditionally, technology adoption literature has emphasized perceived usefulness and perceived ease of use as the most important determinants of technology adoption (Davis, Bagozzi, & Warshaw, 1989; Venkatesh & Davis, 2000). Other factors that potentially influence groupware adoption, are considered to influence technology adoption only indirectly via these two determinants (Davis et al., 1989). We therefore hypothesize that students with higher levels of psychological safety will be more positive about the groupware’s utility, since its potential is not obstructed by the risk of undesired behaviors of others. These students will also perceive the technology to be easier to use since complications in system usage will be voiced and dealt with immediately. We therefore hypothesize:

\[ H5: \text{A student’s assessment of his psychological safety positively influences his perceived usefulness of the groupware technology.} \]

\[ H6: \text{A student’s assessment of his psychological safety positively influences his perceived ease of use of the groupware technology.} \]

3.4. The moderating role of offline communication frequency

Communication frequency describes how often an individual engages in a process of sharing and creating information in order to reach a mutual understanding (Johnson & Lederer, 2005). In psychology and organi-
zational behavior literature, clear and sufficient communication between managers and subordinates, as well as between peers, is often heralded as being critical in change processes, including the introduction of technology (Chawla & Kelloway, 2004; Wanberg & Banas, 2000). Some recent studies in these fields have emphasized the importance to model the moderating impact of communication frequency in performance relationships. Kacmar et al. (2003) show a moderating effect of communication frequency on the relationship between leader-member exchange (LMX) and job-performance ratings. When low frequencies of communication limit feedback and developmental attention, uncertainty arises, leaving employees unable to translate their high-quality relationship into improved performance. Becerra and Gupta (2003) argue that with greater frequency of communication positive characteristics of the environment (e.g. safety) become more visible to employees and therefore have larger impact on their job performance and evaluations.

In the context of groupware, studies suggest that a certain amount of offline communication should supplement the online communication processes to enable groupware adoption and successful use (Benbunan-Fich et al., 2002; Dennis & Reinecke, 2004; Kelly & Jones, 2001). Therefore, in our study, the outcomes of psychological safety might be contingent on the level of offline communication frequency a student exercises with his/her peers and tutor. When offline communication levels increase, it is easier for fellow students to explain and demonstrate the functioning of a technology. Likewise, several studies have shown related processes, such as individualized training, coaching, and support, to reduce feelings of technological complexity (Schillewaert, Ahearn, Frambach, & Moenaert, 2005; Venkatesh, 1999). Additionally, frequent offline communication helps students understand to what extent technology can support study processes (Johnson & Lederer, 2005; Lind & Zmud, 1991). Effort saved due to improved communication and lower uncertainty may be redeployed to interacting with the technology, enabling a person to have more positive technology perceptions for the same level of effort (cf. Davis et al., 1989, p. 987). We therefore hypothesize that an appropriate level of offline communication frequency both with one’s peers as well as with one’s tutor are preconditions for reaping the benefits of psychological safety. Hence, we posit,

\[ H7a: \text{The positive effect of psychological safety on perceived usefulness will be stronger for students with a high offline communication frequency among peers.} \]
\[ H7b: \text{The positive effect of psychological safety on perceived ease of use will be stronger for students with a high offline communication frequency among peers.} \]
\[ H8a: \text{The positive effect of psychological safety on perceived usefulness will be stronger for students with a high communication frequency with the tutor.} \]
\[ H8b: \text{The positive effect of psychological safety on perceived ease of use will be stronger for students with a high communication frequency with the tutor.} \]

3.5. Perceived usefulness and perceived ease of use

Traditionally, technology adoption literature has emphasized the key roles of perceived usefulness and perceived ease of use in introducing new technologies, due to the popularity of the Technology Acceptance Model (TAM) (Davis et al., 1989; Venkatesh & Davis, 2000). In general, these two technology perceptions have constituted a significant influence on an individual’s intention to use a technology or system (Schepers & Wetzels, 2007). The mediating role of attitude between these perceptions and behavioral intention has been doubtful from the start of TAM and has therefore not been considered in later assessments of the model (Venkatesh & Davis, 2000). Consistent with research trends and empirical findings in the field of technology adoption, we therefore hypothesize:

\[ H9: \text{A student’s perceived ease of use of the technology positively influences his perceived usefulness of the technology.} \]
\[ H10: \text{A student’s perceived usefulness of the technology positively influences his groupware usage.} \]
\[ H11: \text{A student’s perceived ease of use of the technology positively influences his groupware usage.} \]

The hypotheses described above form our conceptual model, depicted in Fig. 1.
4. Methodology

4.1. Data collection and sample characteristics

We created an experimental groupware setting for Dutch university students. For a course on management of organizations, students were clustered in groups of 5–15 members. Each student fulfilled weekly assignments, and was encouraged to use fellow group students to increase and improve his own insights. In past years, students mostly communicated face-to-face and through e-mail. We now supplied a number of student groups with a supporting tool for collaboration specifically designed for this research. This groupware enabled students to exchange documents, ask questions via forums and chatboxes, access online information resources, obtain lecture slides, and read the latest news on the course. Besides the new experimental communication platform, 12 two-hour tutorial group meetings were scheduled during the 8-week course.

The implicit goal of the offline sessions was to enable effective learning in small groups, and each student was expected to contribute to group discussions. As an incentive to do so, active participation was rewarded with bonus points added to the overall course grade. The tutorial group meetings were chaired by a tutor, with each group consistently assigned the same tutor. Tutors were expected to stimulate discussion and creativity, guide discussions when necessary, stimulate a thorough analysis of assigned student tasks, and formulate relevant learning goals. Furthermore, he or she acted as a contact person for a wide range of student problems and questions. Since students were working in groups, were dependent on one another for successful completion of the course, were influenced by a tutor both inside and outside their tutorial sessions, and their work involved using groupware, the setting above is regarded as a suitable research context for our study.

Fig. 1. Conceptual model.
Data were collected by means of a questionnaire, distributed by tutors in the break of the second-to-last two-hour tutorial session. Of the 869 questionnaires distributed, 361 completed questionnaires were collected, yielding a response rate of 41.5%. Of these 361 respondents, 251 (69.5%) were male, 110 (30.5%) were female. The minimum age was 17 years, the maximum age 33 years. The average age was 19.43 years with a standard deviation of 1.64 years.

4.2. Measurement

All latent constructs, except for groupware usage, were operationalized by multi-item scales validated in previous studies. Participants indicated their (dis)agreement with a set of statements using a 7-point Likert-type scale that ranged from strongly disagree to strongly agree. Psychological safety was measured with five items adapted from scales by Edmondson (1999) and May et al. (2004). Perceived tutor support and perceived peer support were both assessed with four items adapted from Eisenberger et al. (1986). Self-consciousness was measured with three items adapted from Fenigstein, Scheier, and Buss (1975). The constructs offline communication frequency with peers and tutor were operationalized by three items each, which were adapted from Johlke and Duhan (2000) and Johlke, Duhan, Howell, and Wilkes (2000). The four traditional items proposed by Davis et al. (1989) for both perceived usefulness and perceived ease of use were used in this study. Finally, groupware usage was operationalized with three newly developed items, each measuring the frequency of accessing one specific software component of the groupware. The items assessed the frequency of accessing the groupware’s shared documents repository, contributing to the discussion forum, and the usage of the group messaging function. In contrast to other scales, respondents answered the questions on a scale ranging from “never” (1) to “more than once a day” (7).

5. Data analysis and results

5.1. Validity and reliability

To verify the validity and reliability of the measures we conducted a confirmatory factor analysis (CFA; Anderson & Gerbing, 1988) at the individual-level of analysis. Using the robust maximum likelihood estimator in AMOS 5.0 (Arbuckle, 2003) revealed an acceptable fit to the data: $\chi^2(459) = 806.16 \, (p < 0.001)$; TLI = 0.93; CFI = 0.94; RMSEA = 0.05; SRMR = 0.05. All items loaded significantly on the hypothesized latent variables to provide evidence for convergent validity (Anderson & Gerbing, 1988). Using the robust standard errors, we calculated 95% confidence intervals for the estimates of the intercorrelations among the latent variables to assess discriminant validity. For all possible correlation pairs, the value one was not included in the interval, indicating discriminant validity (Anderson & Gerbing, 1988). We also assessed the change in $\chi^2$ when fixing covariance paths to one consecutively in our structural model. When the fit significantly decreases, the pair of constructs can be discriminated. For all construct pairs, model fit significantly decreased, yielding further evidence for discriminant validity. Finally we calculated the composite reliability for each latent construct to assess the reliability of our scales. Since all values exceeded the commonly accepted threshold of 0.70, we conclude that our measures are reliable. Table 1 shows the details of the analyses above.

5.2. Justification for aggregation

To estimate and compare individual-level and group-level effects of social support on psychological safety, the antecedents have to be split in an individual score and the group mean. Thereafter, the individual-level component is used as a control for its group-level analogue in a multi-level regression equation with psychological safety as the dependent variable. If the group-level coefficient remains significant after adding the individual-level effect to the regression equation, this coefficient explains incremental, unique variance in psychological safety that cannot be captured by the individual-level coefficient (De Jong et al., 2005).

In order to empirically justify data aggregation to the team level for the social support constructs using the group means, we calculated the $r_{WG(j)}$ statistic and intra-class correlation (ICC) coefficients for perceived tutor support and perceived peer support. The $r_{WG(j)}$ coefficient is an indicator of homogeneity of individual ratings.
<table>
<thead>
<tr>
<th>Construct/item</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Standardized factor loading</th>
<th>Composite reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perceived tutor support</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My tutor appreciates any extra effort from me</td>
<td>5.49</td>
<td>1.17</td>
<td>0.71</td>
<td></td>
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<tr>
<td>My tutor would ignore any complaint from me (R)</td>
<td>5.94</td>
<td>1.03</td>
<td>0.64</td>
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<td>Even if I did the best job possible, my tutor would fail to notice (R)</td>
<td>6.04</td>
<td>1.10</td>
<td>0.81</td>
<td></td>
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<td>My tutor shows a lot of concern for me</td>
<td>5.51</td>
<td>1.25</td>
<td>0.67</td>
<td></td>
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<tr>
<td><strong>Perceived peer support</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The students in my group appreciate any extra effort from me</td>
<td>5.36</td>
<td>1.14</td>
<td>0.66</td>
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<td>5.72</td>
<td>1.04</td>
<td>0.71</td>
<td></td>
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<td>Even if I did the best job possible, the students in my group would fail to notice (R)</td>
<td>5.79</td>
<td>1.06</td>
<td>0.77</td>
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<tr>
<td>The students in my group show a lot of concern for me</td>
<td>5.43</td>
<td>1.14</td>
<td>0.71</td>
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</tr>
<tr>
<td><strong>Self-consciousness</strong></td>
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<td></td>
<td>0.70</td>
</tr>
<tr>
<td>I worry how others perceive me in my group</td>
<td>2.60</td>
<td>1.41</td>
<td>0.69</td>
<td></td>
</tr>
<tr>
<td>I am afraid my failings will be noticed by others in my group</td>
<td>2.51</td>
<td>1.35</td>
<td>0.71</td>
<td></td>
</tr>
<tr>
<td>I don’t worry about being judged by others in my group (R)</td>
<td>2.91</td>
<td>1.52</td>
<td>0.59</td>
<td></td>
</tr>
<tr>
<td><strong>Psychological safety</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.74</td>
</tr>
<tr>
<td>I’m not afraid to express my opinions in my group</td>
<td>5.24</td>
<td>1.11</td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td>I am afraid to express my opinions in my group (R)</td>
<td>5.74</td>
<td>1.21</td>
<td>0.55</td>
<td></td>
</tr>
<tr>
<td>There is a threatening environment in my group (R)</td>
<td>6.02</td>
<td>1.03</td>
<td>0.70</td>
<td></td>
</tr>
<tr>
<td>I feel safe to take a risk in my group</td>
<td>5.80</td>
<td>1.25</td>
<td>0.72</td>
<td></td>
</tr>
<tr>
<td>I feel it is difficult to ask other students in my group for help (R)</td>
<td>6.38</td>
<td>0.93</td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td><strong>Offline communication frequency with tutor</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.87</td>
</tr>
<tr>
<td>My tutor and I frequently communicate face-to-face</td>
<td>4.30</td>
<td>1.39</td>
<td>0.89</td>
<td></td>
</tr>
<tr>
<td>My tutor and I regularly communicate offline, without using (the system)</td>
<td>4.25</td>
<td>1.36</td>
<td>0.92</td>
<td></td>
</tr>
<tr>
<td>I often discuss work with my tutor face-to-face</td>
<td>3.62</td>
<td>1.36</td>
<td>0.67</td>
<td></td>
</tr>
<tr>
<td><strong>Offline communication frequency with peers</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.82</td>
</tr>
<tr>
<td>The students in my group and I frequently communicate face-to-face</td>
<td>5.54</td>
<td>1.08</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>The students in my group and I regularly communicate offline, without using (the system)</td>
<td>5.63</td>
<td>1.08</td>
<td>0.82</td>
<td></td>
</tr>
<tr>
<td>I often discuss work with the students in my group face-to-face</td>
<td>5.19</td>
<td>1.37</td>
<td>0.64</td>
<td></td>
</tr>
<tr>
<td><strong>Perceived usefulness</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.90</td>
</tr>
<tr>
<td>Using (the system) improves my study performance</td>
<td>4.41</td>
<td>1.48</td>
<td>0.83</td>
<td></td>
</tr>
<tr>
<td>Using (the system) increases my study productivity</td>
<td>4.44</td>
<td>1.42</td>
<td>0.84</td>
<td></td>
</tr>
<tr>
<td>Using (the system) enhances my study effectiveness</td>
<td>4.42</td>
<td>1.37</td>
<td>0.88</td>
<td></td>
</tr>
<tr>
<td>I find (the system) to be useful in my study</td>
<td>4.98</td>
<td>1.41</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td><strong>Perceived ease of use</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.86</td>
</tr>
<tr>
<td>My interaction with (the system) is clear and understandable</td>
<td>4.61</td>
<td>1.50</td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td>Interacting with (the system) is clear and understandable</td>
<td>5.00</td>
<td>1.39</td>
<td>0.56</td>
<td></td>
</tr>
<tr>
<td>I find (the system) to be easy to use</td>
<td>4.63</td>
<td>1.70</td>
<td>0.92</td>
<td></td>
</tr>
<tr>
<td>I find it easy to get (the system) to do what I want it to do</td>
<td>4.50</td>
<td>1.64</td>
<td>0.84</td>
<td></td>
</tr>
<tr>
<td><strong>Groupware usage</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.77</td>
</tr>
<tr>
<td>Over the past weeks, I have accessed the shared document repository on (the system)</td>
<td>5.54</td>
<td>1.14</td>
<td>0.86</td>
<td></td>
</tr>
<tr>
<td>Over the past weeks, I have contributed to discussions on the discussion forum on (the system)</td>
<td>5.25</td>
<td>1.26</td>
<td>0.72</td>
<td></td>
</tr>
<tr>
<td>Over the past weeks, I have used the group messaging function of (the system)</td>
<td>5.25</td>
<td>1.61</td>
<td>0.57</td>
<td></td>
</tr>
</tbody>
</table>

(R) indicates reversely coded items, mean scores display means after recoding.
within teams. It provided high median values for both variables \((r_{WG(j)} = .91\) for both perceived tutor support and perceived peer support). These findings indicate that individual ratings within groups had a high degree of consistency (James, Demaree, & Wolf, 1993). As an additional measure, the ICC coefficient comprises a ratio of between-groups variance to total variance. The ICC values corrected for measurement error were significant for both perceived tutor support and perceived peer support \((F\text{-values } p < 0.05)\). This indicates that each variable possessed a significant amount of between-group variance. Accounting for group size, and therefore more precisely assessing the impact of interdependence, ICC(2) measures were, respectively, 0.50 (for perceived tutor support) and 0.60 for (perceived peer support) yielding evidence for reliable group means (Bliese, 2000).

5.3. Multi-level analysis results

The findings of the multi-level analysis are presented in Table 2. Model 1 is the base model, while Model 2 includes the hypothesized interaction effects. Both models show a higher \(R^2\) at the group-level than at the individual-level, indicating that between-groups variation of psychological safety can be better explained by the antecedents than within-group variation. Including the interaction effects, Model 2 shows a significantly better fit than Model 1 \((\chi^2(3) = 128.89, p < 0.01)\) and also has substantially more explanatory power than its predecessor. It reveals positive individual-level effects of tutor and peer support, providing support for H1 and H2, respectively. At the group-level of analysis, we found a positive effect of tutor support only, thereby supporting H3a. No support was found for H3b since the group-level effect of peer support was nonsignificant.

In testing H1–H4 we controlled for the effects of team size on psychological safety. We did so since Edmondson (2004) suggests that levels of psychological safety can differ with team size, and urges future research to investigate this issue. Our results show that team size as well as its square significantly relate to

| Table 2 | Results of Multi-Level Analyses of Antecedent–Psychological Safety Relationship |
|---------|----------------------------------|----------------------------------|-----------------
|         | Model 1                          | Model 2                          | Hypothesis      |
|         | Intercept \(4.342\) (0.533)       | Intercept \(4.323\) (0.448)       |                 |
| Individual-level variables | | | |
| Perceived tutor support \(0.206\) (0.056)** | Perceived tutor support \(0.136\) (0.045)** | 0.163   | H1 |
| Perceived peer support \(0.186\) (0.054)** | Perceived peer support \(0.098\) (0.048)* | 0.115   | H2 |
| Self-consciousness \(-0.334\) (0.028)** |          | -0.493  |                 |
| Group-level variables | | | |
| Team size \(-0.069\) (0.021)** | Team size \(-0.041\) (0.017)** | -0.120  |                 |
| (Team size)\(^2\) \(-0.021\) (0.006)** | (Team size)\(^2\) \(-0.019\) (0.005)** | -0.196  |                 |
| Perceived tutor support \(0.224\) (0.133)* | Perceived tutor support \(0.206\) (0.111)* | 0.100   | H3a |
| Perceived peer support \(-0.155\) (0.129) | Perceived peer support \(-0.089\) (0.109) | -0.046  | H3b |
| Interactions | | | |
| Self-consciousness \(\times\) Perceived tutor support | | | |
| Self-consciousness \(\times\) Perceived peer support | | | |
| Increase in model fit\(^c\) \(\chi^2(2) = 2.787\) | Increase in model fit\(^c\) \(\chi^2(3) = 128.89**\) | | |
| Explained variance (%) | | | |
| Individual-level | 22.4 | 45.7 | |
| Group-level | 51.7 | 66.2 | |

Notes: \(N_{\text{teams}} = 36, N_{\text{individuals}} = 361\). Significance is based on one-tailed tests.

* Unstandardized regression coefficients.

b Standard errors between parentheses.

\(^c\) The increase in model fit relative to the previous model.

\(p < 0.05\)

** \(p < 0.01\)
psychological safety, indicating a negative exponential relationship. Therefore, slightly larger teams of students score much lower on psychological safety. Probably, these teams are more likely to have interpersonal conflicts because of conflicting characters.

Regarding the interaction effects with the individual trait self-consciousness, we found a significant positive interaction effect involving peer support, supporting H4b. Furthermore, the interaction term involving tutor support was nonsignificant, H4a is therefore rejected.

5.4. Structural model of consequences

To verify the second part of our research model, involving the consequences of psychological safety and their interconnections, we included all hypothesized relationships in a structural equation model (SEM) and used AMOS 5.0 (Arbuckle, 2003) for estimations. We estimate this part of the research model using the robust maximum-likelihood estimator. The model showed good fit with $\chi^2(99) = 213.71$; TLI = 0.95; CFI = 0.96; RMSEA = 0.06; SRMR=0.06. All statistics adhered to commonly accepted Hu and Bentler (1999) guidelines.

Regarding the path coefficients and corresponding significance values, all relationships in the model were significant at the $p < 0.05$ level, thus yielding support for H5, H6, H9, H10, and H11. In addition, we specified offline communication frequency as a moderator in several of these relationships. As a procedure to calculate effects, the sample was first split in high and low groups. This identified individuals which were high in their communication frequency with their tutor and peers, respectively, and those which were low in their frequency of communication. We did so using a third split, taking only students of the lowest scoring third part (i.e. 33.3%) and highest scoring third part of the sample regarding offline communication frequency into consideration. This practice is commonly accepted in behavioral and personality research, besides the more traditional and conservative median split, since respondents end-pile their ratings (Dabholkar & Bagozzi, 2002; McCarty & Shrum, 2000). We found that offline communication frequency with peers positively moderates the impact of psychological safety on perceived ease of use ($\Delta\chi^2(1) = 6.4$). Here, for the low group ($n = 86$) the coefficient of the relationship was $-0.03$ and nonsignificant, while the high group ($n = 149$) displayed a coefficient of 0.32 which is significant at the $p < 0.01$ level. Table 3 gives an overview of the hypotheses testing.

In addition, we tested for a direct effect of psychological safety on groupware usage. Our reason to do so was threefold. First, psychological safety appears to be a key construct in other studies on technology adoption (Edmondson et al., 2001; Edmondson, 2004). Second, the general principle that external variables can only influence technology perceptions or their relative weights (Davis et al., 1989) has been falsified by numerous studies finding direct effects of individual traits, or technology/institutional characteristics, on usage

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Path coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>H5: PS $\Rightarrow$ PU</td>
<td>$0.11^*$</td>
</tr>
<tr>
<td>H6: PS $\Rightarrow$ PEOU</td>
<td>$0.13^*$</td>
</tr>
<tr>
<td>H7a: OCFT moderates PS $\Rightarrow$ PU</td>
<td>Non-significant</td>
</tr>
<tr>
<td>H7b: OCFT moderates PS $\Rightarrow$ PEOU</td>
<td>Non-significant</td>
</tr>
<tr>
<td>H8a: OCFP moderates PS $\Rightarrow$ PU</td>
<td>Significant</td>
</tr>
<tr>
<td>H8b: OCFP moderates PS $\Rightarrow$ PEOU</td>
<td>Non-significant</td>
</tr>
<tr>
<td>H9: PU $\Rightarrow$ GU</td>
<td>$0.44^{**}$</td>
</tr>
<tr>
<td>H10: PEOU $\Rightarrow$ GU</td>
<td>$0.33^{**}$</td>
</tr>
<tr>
<td>H11: PEOU $\Rightarrow$ PU</td>
<td>$0.51^{**}$</td>
</tr>
</tbody>
</table>

Model fit

$\chi^2(99) = 213.71$
TLI = 0.95
CFI = 0.96
RMSEA = 0.06

PS = Psychological Safety; OCFT = Offline Communication Frequency with Tutor; OCFP = Offline Communication Frequency with Peers; PU = Perceived Usefulness; PEOU = Perceived Ease of Use; GU = Groupware Usage.

* $p < 0.05$.
** $p < 0.01$.
behavior. For instance, Gefen, Karahanna, and Straub (2003) show consumer trust in an e-vendor to directly relate to intention to use online shopping, and Pavlou (2003) shows perceived risk to be a direct negative determinant of consumer acceptance of e-commerce. Third, by testing the existence of a direct path in our structural model allows us to make statements whether perceived usefulness and perceived ease of use fully or partially mediate the mentioned relationship between psychological safety and groupware usage.

The additional path was found significant ($\beta = 0.12, p < 0.05$) and the resulting model did also display an improved fit ($\Delta \chi^2/d.f. = 4.9, p = 0.027$). Furthermore, the effects of psychological safety on the two technology perceptions as well as the effect of these perceptions on groupware usage remained significant. This gives evidence for a partially mediated chain of relations. Further evidence was obtained by performing a Sobel mediation test (Sobel, 1982). This test showed non-significant $Z$ values for the mediation of perceived usefulness ($Z = 1.429, p = 0.153$) and for the mediation of perceived ease of use ($Z = 1.444, p = 0.149$).

Additionally, we tested whether offline communication frequency with tutor and peers showed any significant interaction effects with psychological safety in influencing groupware usage. We find a significant moderation effect of offline communication frequency with tutor strengthening the positive impact of psychological safety on groupware usage ($\Delta \chi^2(1) = 6.4$). For students with low frequencies ($n = 115$) the standardized coefficient of the relationship is $-0.03$ and nonsignificant, while the high frequency group ($n = 136$) shows a coefficient of $0.29$ and significance at $p < 0.01$ level.

6. Discussion and conclusion

The key objective of this study is to demonstrate that psychological safety plays an important role in successful educational groupware implementation. Until now, this relatively new construct has mainly shown its usefulness in medical settings, but given the characteristics of our educational setting, we expected positive outcomes of psychological safety here as well. To begin with, we calculated a multi-level model of psychological safety antecedents. Second, we formulated a structural equation model to assess the outcomes of psychological safety. Both models were tested in the context of a groupware system specifically designed for a course on management of organizations by university students.

First, we find that psychological safety has a significant impact on perceived usefulness and perceived ease of use of groupware. Moreover, psychological safety also has a direct effect on groupware usage. Apparently, students who feel more safe and comfortable in their environment have less anxiety to use groupware. They show more positive overall attitudes towards the system, and are therefore also more inclined to continue its use. Our study provides empirical evidence on the importance of a psychologically safe environment as a facilitator of groupware implementation. We therefore add to literature on psychological safety, which mainly pinpoints the role of safety feelings in team and individual work outcomes (Baer & Frese, 2003; Brown & Leigh, 1996; Edmondson, 1999).

Additionally, we find that both tutor support and peer support influence feelings of psychological safety at the individual level. This finding extends existing research as it empirically substantiates the notion that supportive processes are important antecedents of psychological safety (Edmondson, 2004; Edmondson et al., 2001). Students who feel that tutor and peers value their contribution and care about their well-being, perceive their study environment to be safer. Moreover, we find a group-level effect of tutor support on psychological safety. Apparently, not only individual study-related perceptions, but also shared perceptions among students about the level of support of the tutor in their group are an important determinant of psychological safety. Team members perceive that their tutor treats them as a group, rather than a collection of individuals. This triggers a synergetic “we are in it together” mentality, which has been shown to be important in enhancing team innovativeness, adaptability, and learning (Edmondson, 1999; Tjosvold, Yu, & Hui, 2004; West & Anderson, 1996). Since members share their beliefs on the level of tutor support, nobody feels socially isolated, and group cohesiveness is higher. From an organizational behavior perspective, since tutors are agents of the educational institution, having responsibility for directing and evaluating students’ performance, students view their tutor’s favorable or unfavorable orientation toward them as indicative of the institution’s teaching capabilities (cf. Eisenberger et al., 1986). A positive social environment in the classroom and in the institution is related to student’s motivation, engagement, and achievements. For instance, they are more motivated to
develop competence (Patrick, Ryan, & Kaplan, 2007) and accordingly have more questions and are less inhibited to ask them (Karabenick & Sharma, 1994). These effects can also be achieved by peer support (supported by our individual-level findings) and for younger students even by parental support (Wentzel, 1998).

Further exploring the effects of shared perceptions, we did not find a significant group-level effect of peer support on psychological safety. This result could potentially be due to our research setting. Interpersonal assistance is specifically needed in stressful, high-performance situations where every individual strives for the overarching team goal. If team members have a strongly synergetic view on the supportiveness of peer relations, this diminishes task and interpersonal ambiguity (Stamper & Johlke, 2003). While the group process was crucial in achieving a good grade, with participation yielding bonus points and the option of helping each other with individual exercises, there was no stress or ambiguity involved in reaching a common goal. Hence, synergy in beliefs on peer support were less important in the determination of levels of psychological safety.

In addition, we find a significant moderation effect of self-consciousness between group-level perceived peer support and psychological safety. This nuances findings in experimental psychology, where the theory of reflexive consciousness predicts that an increased level of self-consciousness will lessen the influence of primes, or stimuli, inconsistent with personal standards (Hull, Slone, Meteyer, & Matthews, 2002). According to this theory, individuals who are highly sensitive to their social environment and other team members’ judgments would prefer to do their work individually. Thus, shared opinions would have less influence on their level of psychological safety. Our results however, indicate that if students worry about how they are perceived and judged by other group members, they adhere more to shared perceptions which significantly strengthens the positive relationship between peer support and psychological safety. Next, we did not find self-consciousness to moderate the relationship between perceived tutor support and psychological safety. It seems that individuals differing in self-consciousness equally engage in shared perceptions of tutor support. This could be explained by the fact that all tutors were encouraged to stimulate open discussions, invite input, and support interaction.

Finally, our results highlight the importance of a decent level of offline communication in groupware adoption. This corroborates findings in groupware literature that offline contact should supplement online contact via groupware (Benbunan-Fich et al., 2002; Dennis, Wixom, & Vandenberg, 2001; Kelly & Jones, 2001). We find a differential effect of offline communication frequency with one’s tutor versus offline communication frequency with one’s peers. To begin with, a student’s offline communication frequency with his tutor positively moderates the relationship between psychological safety and groupware usage, such that this positive relationship is strengthened. In contrast, an individual’s offline communication frequency with his peers positively moderates the relationship between psychological safety and perceived ease of use, again strengthening the existing positive relationship. This difference might be attributed to the fact that the tutor appears to be more relevant when it comes to directly encouraging the use of a technology in everyday work processes and tasks, compared to colleagues (Schillevaert et al., 2005). Particularly in mandatory adoption settings, a tutor, manager, or supervisor has the initial commitment to successfully implement the technology. Frequently, it is his task to get people involved with the system. Therefore, if students or employees get well-funded and convincing feedback by a committed superordinate, this strengthens their groupware usage. On the other hand, individuals on the same hierarchical level are well suited for helping each other out with problems they experience in working with the technology. An abundance of research states that peer support and codiscovery learning are effective mechanisms to acquaint people with a technology (Gallivan, Spitler, & Koufaris, 2005, pp. 159–160). Therefore, if individuals feel safe and speak with their peers, the amount of communication positively influences their perceptions of system usability. However, the commitment of peers towards using the system is lower, possibly explaining the differential moderating effect. In sum, it seems that both a decent level of communication with one’s tutor as well as with one’s peers is necessary to reap the potential benefits of psychological safety in technology implementation and adoption.

From a more practical perspective, our research results imply that tutors should create a psychologically safe, non-threatening work environment for their subordinates, as a way to enhance groupware adoption. A safe environment triggers more positive attitudes towards the groupware technology and makes students more inclined to use the system. As strategies for enhancing the level of psychological safety, previous literature has emphasized building interpersonal relationships based on trust and using practice fields, such as groupware prototypes (Edmondson, 2004). This study gives tutors more detailed directions by relating social support to psychological safety.
Additionally, tutors should ascertain that students treat each other with respect and dignity and value each others’ input in order to stimulate a non-threatening environment. They can do so by setting a good example themselves. Especially changing students’ attitudes can be difficult since it might entail changing interpersonal and “organizational” culture values, something which is notoriously hard to do (Ostroff, Kinicky, & Tamkins, 2003; Schein, 2004). We therefore suggest the development of interpersonal relationships where tutors are supportive, and not controlling, in their interactions with students (Brown & Leigh, 1996; Edmondson, 1999). This allows students to try and experiment. Additionally, tutors should give students freedom of choice and control over their work instead of being rigid, inflexible and controlling with regard to used work methods.

Furthermore, our findings indicate that shared perceptions of a team regarding tutor support also significantly contribute to individual safety perceptions. Therefore, in creating consensus among students about the supportive strategy in their group, tutors should focus their attention on the group as a whole rather than individually monitoring its members. We advocate refraining from personal politics, preferring the interest of particular people (including the self) above that of others. Moreover, team procedural justice should be stimulated. This is the fairness of the decisions to determine the distribution of resources among team members (Greenberg, 1990). The key ingredient is to treat students with dignity and respect, and openly provide information how organizational policy outcomes (e.g. course grades) are determined. Finally, offering collective training and practice sessions with the groupware will both enhance support perceptions (Rhoades & Eisenberger, 2002) as well as psychological safety directly (Edmondson, 2004).

For some individuals, supportive relationships within a team are more beneficial than for others. Students who are afraid of being judged and criticized by others and therefore have a high level of self-consciousness, adhere more to shared perceptions of peer support. Therefore, for individuals of this nature, this type of support is essential in enhancing psychological safety. Tutors should therefore carefully consider each student’s personality and assure that the general level of peer support in a group where members with high self-consciousness reside is of a decent standard.

Finally, an important finding of our research is that the offline communication frequency with one’s tutor and peers can considerably strengthen the positive effects of psychological safety. Tutors should therefore optimize both the tutor–student as well as the student–student communication flows in order to reap the full benefits of a psychologically safe environment. One possibility is arranging joint (social) activities to foster team building and strengthen the shared values.

7. Implications for future research and limitations

Our study opens several opportunities for future research. First, the empirical results show the importance of social processes and support in technology adoption. Future studies should further explore the role of socially constructed variables in a psychological safety framework. However, while these predictor variables reflect important interpersonally oriented behaviors, future studies could also add conceptual richness by considering the impact of technical-administrative or task-related procedures and behaviors. Constructs like role clarity (Brown & Leigh, 1996) and empowerment (Valadares, 2004) deserve attention in this respect, especially when the setting is a business environment.

Second, and additionally, our study enhances our understanding of the impact of antecedent–psychological safety relationships across levels of analysis and thereby demonstrates the multi-level nature of psychological safety and its determinants. Although recent team-related research streams increasingly recognize the importance of comparing relationships across levels (Ostroff, Kinicky, & Clark, 2002), conceptual notions have been rarely discussed in groupware research. Therefore, future research should investigate whether variance in support perceptions among team members is also a relevant issue in (non-)educational teams differing in tasks and member characteristics.

Concerning different tasks, while Edmondson et al. (2001) find psychological safety to be important in cardiac surgery teams using a new surgery technology, this study extends this conclusion to an educational context. We find effects despite the fact that procedures and teamplay around a surgery table differ widely from the practices in our setting. Future research might consequently elaborate on relationships and effect sizes in still other contexts where people’s interdependency is higher or outcomes are more uncertain. May et al. (2004)
state for instance that relationships involving psychological safety may be stronger for more complex, uncertain, creative tasks than for those that are relatively simple and well defined.

Concerning member characteristics, our study is based on a sample of university students. Therefore, our findings should be interpreted with care when trying to generalize them beyond the educational context. Future research should therefore ideally use real business-related data to further explore the concept of psychological safety. Additionally, we used a cross-sectional research design where measurement took place at a fixed point in time. While groupware usage is expected to be a relatively stable phenomenon, the distribution of the questionnaire after seven weeks of experience with the system remains an arbitrary time period. Longitudinal research can produce even more insightful results.

Third and finally, while we find an important moderating role of offline communication frequency, surprisingly little is known about the role of interpersonal communication in the field of technology adoption. While subjective norm has been studied relatively often (cf. Venkatesh, Morris, Davis, & Davis, 2003), our findings illustrate that there is more to the equation than just social pressure to adopt. Future research could focus on communication characteristics, including communication mode (used channel, channel media richness), communication direction (unidirectional, bidirectional), or more objective measurements of communication frequency (preferred number of messages or meetings).

References


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