Please Don't Shoot the Messenger! Prompts in Online Learning Groups - Influences of Nudging Messages' Sender and Publicness on Recipients' Perception and Attribution

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Abstract: Co- and socially shared regulation of learning is a challenge for groups in diverse environments – offline and online (Järvelä et al., 2014). Specifically, prompting others to do their share of the work, might be challenging for interpersonal relationships. Thus, addressing the social psychological dynamics in online learning environments, an online experiment was conducted (N = 352). In a 2x(2x)2 between-subjects design the nature of the sender (group member/system), the sender´s past proficiency (high/low) and publicness (private/public message) were varied to explore whether automated mediation can reduce detrimental effects and enhance impartial message perception, sender impression and causal attribution. Contrasts by sender and proficiency demonstrate improved message perception, sender impression and internal causal attribution when prompts were sent by the system instead of average or low proficient fellow students. Among all groups, public nudges indicate more negative, but also more persuasive perception, however system public and private nudges did not differ.

Keywords: nudging, CRL, SSRL, automated group support, mediation perception, attribution

Introduction

High dropout-rates, low levels of participation and course satisfaction are common problems of large online courses (Erdmann et al., 2017). One didactic element that is hailed as potential solution to both, low motivation as well as low understanding is small group cooperation within large online courses. Thereby, "… the interaction process is considered to be a more important element in learning than the outcomes" (Vuopala, Hyvönen, & Järvelä, 2016, p. 26). It has indeed been demonstrated that small group work is related to higher course satisfaction (Bernard et al., 2009). However, to be successful, small group work requires participation and is dependent on group development processes (Walther & Bunz, 2005). Especially when only consisting of few members, the development and existence of small groups might be endangered by dropout-rates and delays of group activities. In order to achieve beneficial social and educational effects, it has been shown to be advantageous when groups are supervised and supported by tutors (Thorpe, 2002). However, in large online courses (e.g. MOOCs) with a high number of small groups, time and staff related capacity is unaffordable. Therefore, one solution might be automated mediation which facilitates interaction in small-groups and prevents common unproductive behaviors. "Nagging" others to do their share of the work has already been identified by educational and social psychologists as one of eight common detrimental problems in small-group collaboration (Strauß, Rummel, Stoyanova, & Krämer, 2018) that might be addressed by an automatic tutor system.

Theoretical background

So far, "nagging" or nudging other group members is barely researched as a social psychological challenge for interpersonal relationships in small group collaboration, hence it has not been clearly defined or conceptualized. The term "nudging" has been defined as a form of soft paternalism helping to defeat cognitive or behavioral biases in decision making, as "any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives" (Wang et al., 2013, p. 376). Nudging is the case, for instance, when displaying driver's current speed instead of forcing them to slow down. Such indirect means have been successfully applied in the context of health or food and for the purpose of online privacy (e.g. Acquisti et al., 2017). Nudging in the current study refers to hints in order to regulate others' activities, i.e. *unbalanced* co- or socially shared regulation of learning (Isohätälä, Järvenoja, & Järvelä, 2017). Thus, in the context of learning groups, nudges can be understood as negative feedback, co- or socially shared regulation of learning, that might lead to task and person conflicts and can be assumed as either beneficial or detrimental. For instance, effective non-individual regulation of learning, as well as task conflicts are beneficial due to the facilitation of group discussions, decision making, performance and knowledge building (Janssen, Van de Vliert, & Veenstra, 1999), but failures and their effects on interpersonal relationships are yet unknown. Furthermore, socially shared regulation of learning was shown not to function well in case of disengagement,

unequal participation and contribution (Isohätälä et al., 2017). Specifically person conflict reduces teams' effective communication and cooperation, tolerance for opposition, and openness to ideas of disliked team members, and simultaneously improves hostile attributions of others' intentions and behaviors (Janssen et al., 1999). Relationship conflict also was found to be linked to decreased perception of task performance (Mohammed & Angell, 2004). While under certain circumstances the more beneficial and desirable task conflict can facilitate group discussions, these can easily transform into more detrimental person conflicts (e.g., due to the fact that group members can hardly distinguish between them, Janssen et al., 1999). An explanation for the misinterpretation of tasks conflicts as person conflicts can be the need for consistency, i.e. disliked positions regarding the task can lead to corresponding personal attitudes toward the author. Furthermore, even justified criticism can generate reciprocal dis-liking and conflicts (Ilgen, Mitschell, & Frederickson, 1981).

Negative feedback has also been shown to have detrimental effects in groups (Gabelica, Van den Bossche, Segers, & Gijselaers, 2012). Additionally, personal remarks and conflict hinder the success of groups' decision making process (Walther, 1996). Socio-emotional concerns like conflicts distract from the substantive task, and are especially time consuming in computer mediated communication (CMC), but can also easily get restricted on purpose in CMC settings (reducing channels, synchronicity etc.). Given the fact that nudging in learning groups occurs specifically based on missing contribution, it resembles feedback which has also been discussed as a possible challenge for interpersonal relationships. Feedback has been defined repeatedly depending on focus and context, as a comparison of actual performance and a desired standard (e.g. Gabelica et al., 2012). Beyond the aforementioned social-psychological perspective on group interaction as needed but potentially dysfunctional, peer interaction has been found to improve performance and learning outcomes – especially when guiding and support is present to avoid less efficient learning behaviors (Diziol, Walker, Rummel, & Koedinger, 2010). Feedback could be a supportive guiding solution, however, besides many benefits, it also turns out to be demotivating and leads to performance decreases (Kluger & DeNisi, 1996). Especially negative feedback can get unfavorable and result in inefficient behaviors (Ilgen & Davis, 2000). Conversely to the readily accepted positive feedback, negative feedback has been shown to be rejected and perceived as invalid and inaccurate (Ditto & Boardman, 1995). On the other hand, it has been found that compared to positive feedback, students prefer more negative feedback, as especially constructive if it points out a lacking goal progress instead of a decrease in engagement (for review see Fishbach, Eyal & Finkelstein, 2010). Similarly, negative feedback was concluded to have potential detrimental effects on members' affective reactions but may also have positive motivational effects (Gabelica et al., 2012), for instance regarding regulation of learning. Thus, research showed contradicting results and similar to conflicts, both detrimental and beneficial effects of negative feedback can be assumed.

Based on these findings it can be assumed that when one group member nudges another detrimental effects occur that endanger group climate and interpersonal relationships. Especially, once negative attribution of a certain group member or group conflicts occur, it can be more difficult to resolve conflicts and repair one's image or the wellbeing on a group level. One potential solution can be an external envoy as a mediator of "negative feedback" that would otherwise needed to be delivered by other group members.

Relevance of feedback source

Feedback can be based on a subjective opinion or an objective measure and derive from an internal or external source. Here, group members might be categorized as an internal feedback source as well as providing a subjective opinion. Automated mediated feedback, such as messages deriving from the system as an external source, might be categorized as potentially based on more objective measures. Feedback is more likely perceived as accurate, when deriving from more credible, powerful or knowledgeable sources (e.g. London & Sessa, 2006). This, however, was mainly shown in the classic teaching context regarding learning processes and outcomes (e.g. Finn et al., 2009).

Gabelica et al. (2012) conclude that feedback intervention effectiveness might be improved if feedback is accurate, given in a timely manner, regular, given directly to teams it targets, *shared*, *non-threatening*, *and when its distribution is fairly equal*. However, these characteristics could vary depending on the source, as notably the last three could not be secured or held constant when feedback is given in a subjective manner by group members, but they can potentially be adjusted explicitly when providing feedback by an external system, as described in the next section regarding the media equation theory.

Past proficiency

Regarding the effects of feedback, it is not only important who the sender is but also his/her attributes and prior behavior will play a role. One important aspect is past proficiency of group members as it has been described in group dynamic theories referring to the term of idiosyncrasy (i.e., possessing unique characteristics or showing unique behavior). In order to be allowed to derogate from a group's normative standards the individual member

must have shown high achievement in the past, i.e. must have earned a high level of "idiosyncrasy credit" (Hollander, 1958). In its origin, it considers leaders acquiring credit over time by performing continuously well and following group norms. As a credit of trust it enables one to deviate from the norms. Applied to learning groups this credit may be a basic factor in the case of the common problems of unequal contribution, social loafers and free riders.

As a recipient of a nudging message one could perceive it as inappropriate to receive any nudging remarks from a member with low past proficiency. Conversely, high past proficiency as a credit of trust and high contributor image as a kind of a group leader could turn into special rights to announce feedback within the group. This may be a fundament for the effectiveness of the message e.g. persuading the recipient to reconsider an act due to higher internal causal attribution.

Media equation theory

Automated support is not simply an accurate and financially effective method to support high number of groups in online learning settings. In the sense of a mediator it could be perceived more impartial and can potentially prevent the occurrence of interpersonal conflicts in the case of nudging group members to do their share of the work. In case negative feedback is being sent by the system it can be less frustrating. As postulated in the media equation theory, interactions with computers and media can be perceived as real life interactions (Reeves & Nass, 1996). People have been demonstrated to treat computers similar to people, e.g. they avoid to deliver directly negative feedback. However, research in the area of information communication technology and human-robot-interaction has already shown some differences and limitations of the media equation theory. For instance, people asked to abuse a robot in an adaption of the Milgram experiment, more likely did so, when abusing a robot instead of a human (Bartneck, Rosalia, Menges, & Deckers, 2005). Furthermore, compared to other humans, virtual humans were shown to increase the willingness to disclose confidential information with them, although they are *only* computers (Lucas, Gratch, King, & Morency, 2014). Hence, it can be assumed that negative feedback from an automated system might be perceived differentially, e.g., as more impartial, since message recipients could not blame the system and its *personal* reasons for presenting feedback. Recipients could still indeed perceive the system as another human and interact with it equally, as the media equation theory postulates. However, the knowledge that "the system" has no past proficiency (neither high nor low) or any personal intentions can be significant for different perception. We assume that even if people blame the system, it would be on a level according to the missing, i.e. neutral past proficiency instead of high or low as in the case of other members' feedback.

Public versus private nudges

Beyond source, the way the message is presented needs to be scrutinized. One important aspect of presenting nudges in groups is whether these are targeted privately at the deviating person or displayed publicly in the group. The psychologically relevant construct in this context is ego threat. Negative feedback might pose an ego threat to one's self-image or public-image (Audia & Locke, 2003). An ego threat of self-image provides information contrary to the own beliefs about the self, whereas for public-image respectively information contrary to one's self targeted impression to others. Less or late contribution can be reasoned diversely, consciously or unconsciously, i.e. fitting or contrary to the self-image. Respectively nudges to hurry up and contribute more can be contrary to or fit the self-image too. However, since people generally tend to have a positive self-concept, prompting messages about their missing contribution could serve as a self-image threat. Indeed, threats to the self-image have already been operationalized by providing negative feedback (Leary, Terry, Allen, & Tate, 2009). Regarding the public-private distinction, the mere presence of others during feedback might be sufficient for a public-image threat since self-presentation is a basic need and ubiquitous. In the current study, it can emerge as soon as negative feedback is given in public in the group forum, i.e. others will also be informed about the presumable failure. Prior research on public and private feedback recommended it to be given in both ways in order to activate all potentially positive effects (Alvero, Bucklin, & Austin, 2001), but differences between both types may occur regarding nudging.

Present study and hypotheses

Based on the reported theories and findings we aim to primarily explore which factors influence the perception of nudging and secondary, whether automated mediation (e.g. prompts sent by the system) can reduce potentially detrimental effects of nudging for interpersonal relationships and group climate. In an online study, in an artificial learning environment, prompt messages from the system as well as from team members will be conceptualized. Participants will imaginarily collaborate in small groups and receive prompting messages by means of visual

mock-ups. The nudging sender (group member vs. system), his proficiency (high vs. low engaged) and the publicness level (nudge in a private vs. group forum message) will be varied as independent variables.

Based on the literature summarized above, we assume differences between the experimental groups regarding causal attribution, emotional affect, sender impression and message perception. The media equation theory postulates, that people interact with machines like they do with humans. However, limitations of the theory already demonstrated different, partially more confidential interactions with machines. Hence, we assume that system nudges will be perceived differently than nudges from human team members – independent of proficiency and publicness. *H1: Compared to prompts from a team member, system prompts improve a) emotional affect, b) sender impression, c) message perception and d) internal causal attribution.*

Beyond this assumption, it cannot be derived whether interaction with the system is still beneficial, when contrasted to humans who showed relevant prior engagement and therefore earned idiosyncrasy credit. We therefore pose the following research questions: *RQ1.1: Compared to prompts from a low proficient team member, do system prompts improve a) emotional affect, b) sender impression, c) message perception and d) internal causal attribution? RQ1.2: Compared to prompts from a high proficient team member, do system prompts improve a) emotional affect, b) sender impression, c) message perception and d) internal causal attribution?*

Concerning the publicness of negative feedback and public ego-threat as hostile acts, we state that publicness has an impact on the negative emotional affect, on sender impression and message perception among all experimental groups: *H2: Publicness has an effect among all experimental groups, that increases a) negative emotional affect and b) negative message perception, but decreases c) persuasive message perception and d) sender impression.*

However, the main effect among all groups does not deliver details to scrutinize which publicness level of system nudges is perceived less threatening. Therefore we explore the effect of publicness in system treatment groups, exclude further influences, and state the research question: *RQ2: Among system treatment conditions, is there an impact of publicness on a) negative emotional affect, b) negative message perception, c) persuasive message perception and d) sender impression?*

Method

Participants were instructed to imagine that they participate in an online learning group, did not provide their contribution shortly before the deadline and therefore received a prompting message. The nudging sender (group member vs. system), past proficiency of sender (high vs. low engaged) and the publicness level (nudge in a private vs. group forum message) were varied as independent variables. The design is not fully crossed as proficiency of the sender can only be varied in the team member conditions, not in the system conditions. To immerse the participants we created visual vignettes based on the view of a group member account in the learning environment Moodle and adapted them to the specific conditions (Figure 1). The group context was described in advance by short texts and charts on the past progress of the group and group members' past proficiency regarding contributions' quantity and timeliness. Participants were presented a prompt message in form of a visual mock-up either from the system or from a high or low proficient teammate, and either as a private (inbox) or public (forum) message. The use of an artificial learning environment allowed us to remind participants of the group context in the main message with the aid of a Moodle tool presenting group members' past online activities.
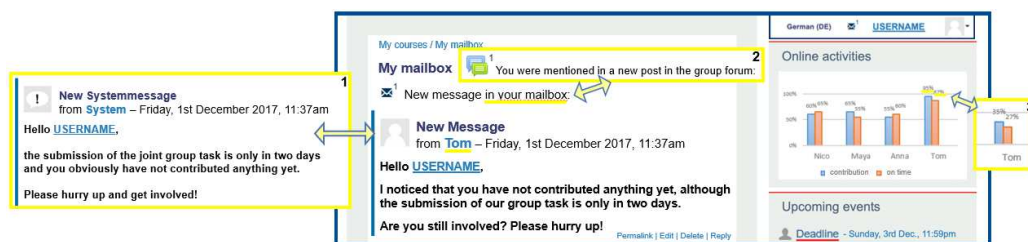

Figure 1. Exemplary vignette with variable conditions (1 = sender, 2 = publicness, 3 = proficiency).

Regarding the *sample*, the study was approved by the ethics committee of the University. A total of 444 participants were randomly assigned to one of the six conditions. They were mainly recruited through advertisements in Facebook groups and incentivized in a lottery. Additionally we used a crowdsourcing website with postpaid incentives. 92 persons were excluded from further analyses as they spent less than 10 seconds at the stimulus material pages (vignettes), their (nick)names were shorter than three letters and due to missing data. The remaining 352 participants (235 female, 117 male (33.2%)) ranged in age from 18 to 69 years ($M = 29.40$, $SD = 10.46$). Most of the participants had a university entrance degree (40.9%) or a higher degree (46.1%) and

were predominantly students (228, 64.8%) with a medium attitude towards group work participation ($M = 2.95$, $SD = 1.04$, 1-5).

Regarding *measures*, adjective item lists were adapted from various affective scales and lists for emotional affect, message perception and sender impression. Finally, for each measure, an explorative factor analysis according to Horn (1965) was conducted and the recommended factor solution was chosen.

Emotional Affect was measured with a list of 23 adjective items, all employing a 5-point Likert scale (1 to 5 = strongly agree). Factor analysis revealed a 3-factor solution: *Positive* affect (α = .841, 8 items, e.g. "inspired"), *negative external* affect (α = .907, 10 items, "humiliated"), and *negative internal* affect (α = .786, 5 items, "guilty").

Message Perception was measured by 18 single items, employing a 5-point Likert scale (1 to 5 = strongly agree) and divided in 3 factors revealed by factor analyses: *Negative* (α = .841, 5 items, "hostile"), *positive* (α = .894, 7 items, "needed") and *fair* (α = .827, 6 items, "impartial"). Additionally, as a further perception dimension, persuasiveness of the message was measured with an adapted version of the perceived persuasiveness scale from Orji, Vassileva and Mandryk (2014), employing a 7-point Likert scale (1 to 7 = strongly agree). An additional self-generated item regarding reluctant behavior was included. One-factor solution was applied – *persuasive* (α = .840, 5 items, "The prompt would persuade me").

Positive Sender Impression. Semantic differentials were applied (e.g. 1 = unfriendly to 5 = friendly) to measure impression from the sender and taken according to factorial analysis as one-factor solution (α = .905, 9 items).

Causal Attribution. We measured how participants attribute why they received the nudging message, whether it was their fault (internal) or others' (external). Based on Lefcourt (1981), 8 items with daily internal and external reasons were generated on a 5-point Likert scale (1 to 5 = strongly agree). After a factor analysis the dimensions were combined in an overall factor *Internal causal attribution* (α = .726, 5 items, "Because I was lazy").

Other Measures. We employed one item measures to assess socio demographics (e.g. age, education, gender), past group work experiences (both quantity and valence), and attitude towards group work. We additionally measured self-esteem, perfectionism, and causal attribution style as traits, as well as further personality traits, which are not relevant for the analyses presented here.

Results

Regarding *hypothesis 1,* after inspecting descriptive values (table 1), a planned comparison was conducted to test whether the system as a nudging agent compared to team members improves a) emotional affect, b) sender impression, c) message perception and d) internal causal attribution. Therefore, we compared both system-

Table 1: Descriptive values of dependent variables across treatment groups

↓DV / Treatment Group→	1. SYpr		2. SYpu		3. TMpr-		4. TMpr+		5. TMpu-		6. TMpu+		Total	
Emotional Affect	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Negative internal	3.75	.77	3.72	.81	3.27	.90	3.72	.77	3.36	.86	3.78	.80	3.59	.84
Negative external	2.47	.96	2.66	.82	2.57	.80	2.62	.92	2.82	.94	2.88	.97	2.67	.91
Positive	2.22	.73	2.34	.75	2.05	.75	2.32	.76	2.16	.72	2.23	.79	2.22	.75
Message Perception														
Negative	2.46	1.05	2.78	.86	2.82	.90	2.57	.98	2.90	.95	2.78	.89	2.72	.95
Positive	3.00	.90	2.95	.77	2.41	.90	2.97	.98	2.52	.94	2.77	.83	2.77	.92
Fair	3.19	.85	2.96	.81	2.68	.90	3.29	.91	2.77	.84	3.12	.71	3.00	.86
Persuasive	5.15	1.41	5.32	1.13	4.28	1.39	4.76	1.45	4.83	1.06	5.10	1.34	4.90	1.33
Positive Sender Impression														
	3.38	.66	3.21	.69	2.86	.85	3.35	.80	2.84	.90	3.23	.70	3.14	.80
Internal Causal Attribution														
	3.86	.55	3.88	.63	3.34	.77	3.68	.72	3.41	.66	3.85	.57	3.66	.69

message-conditions (groups 1 & 2) in planned contrasts to all the team-member-conditions (groups 3, 4, 5 & 6). The contrast revealed significant differences, indicating increased levels in the system conditions regarding internal negative emotional affect, $t(346) = -2.20$, $p = .029$, $r = .12$, but also message perception positive, $t(346) = -2.99$, $p = .003$, $r = .16$, and persuasive, $t(346) = -3.35$, $p = .001$, $r = .18$, generally positive sender impression, $t(263.12) = -2.76$, $p = .006$, $r = .17$, and internal causal attribution, $t(346) = -4.03$, $p < .001$, $r = .13$. *Hypothesis 1* is partially supported since the general comparison of all treatment groups divided by sender showed significant differences and an improvement of the positive and persuasive message perception, sender impression, as well as higher levels of internal causal attribution, whereas, contradicting to *hypothesis 1*, the internal negative emotional

affect was higher. However, the system as a sender, compared to the groups with a team member sender, did not reveal significant differences regarding fair and negative message perception.

Research question 1.1 and *1.2* investigate whether compared to a message sent by a team member with high or low past proficiency, a message sent by the system improves a) emotional affect, b) sender impression, c) message perception and d) internal causal attribution, we conducted planned contrasts. Due to the factor proficiency which was varied in all experimental groups with a team member as a sender, we had to split the analyses to avoid conflicting high and low proficiency to be summarized. Thus, we compared the system-message-conditions (1 & 2) in planned contrasts to the team-member-conditions divided by proficiency. For *RQ1.1* we compared them to those with low past proficiency (exp. groups 3 & 5). Contrasts revealed that a system message, compared to one from a low proficient team member increased internal negative emotional affect, $t(346) = 3.97$, $p < .001$, $r = .21$, message perception, (fair, $t(346) = 3.19$, $p = .002$, $r = .17$, positive, $t(346) = 4.38$, $p < .001$, $r = .23$, and persuasive, $t(346) = 4.04$, $p < .001$, $r = .21$), positive sender impression, $t(223.46) = 4.41$, $p < .001$, $r = .23$, as well as internal causal attribution, $t(346) = 5.81$, $p < .001$, $r = .22$. There were no significant effects on external negative emotional affect and negative perception of the message. Except for these two subscales, the system-message-condition, compared to low proficient team-member-conditions, had an improving effect. For *RQ1.2* we compared both system-message-conditions (1 & 2) to those with high past proficiency team-member-conditions (exp. groups 4 & 6). However, there was no significant difference compared to high proficient team members. *Research question 1.1* revealed that messages from the system compared to those from low proficient team members improved internal causal attribution, positive sender impression, as well as fair, positive and persuasive message perception. However, on the other hand the system had detrimental effects regarding increased internal negative emotional affect. *Research question 1.2* did not reveal significant differences between the system and high proficient members.

Hypothesis 2 was tested in a MANOVA, conducted among all treatment groups to test the influence of publicness on the experimental groups regarding increasing a) negative emotional affect and b) negative message perception, but decreasing c) persuasive message perception and d) sender impression. There was a significant effect of publicness, $V = 0.64$, $F(5, 346) = 4.77$, $p < .000$. Further separate univariate ANOVAs revealed significant effects on a) external negative emotional affect, $F(1, 350) = 5.69$, $p = .018$, $\eta^2 = .016$, b) negative message perception, $F(1, 350) = 4.44$, $p = .036$, $\eta^2 = .013$ and c) persuasive message perception, $F(1, 350) = 5.66$, $p = .018$, $\eta^2 = .016$. However, there was no significant effect on d) sender impression. All significant effects indicated higher levels in public, rather than in private nudges, i.e. more negative emotional affect and more negative, but also more persuasive message perception. Therefore *H2* is partly supported as in the public condition a) negative emotional affect, b) negative message perception and c) persuasive message perception increased, but there was no significant effect on d) sender impression.

Research Question 2 addressed the publicness of a system message and whether public and private system prompts differ regarding a) negative emotional affect, b) sender impression and c) negative and persuasive message perception. Therefore a MANOVA was conducted, by comparing solely the experimental conditions with a system sender. No significant differences were revealed, $V = 0.12$, $F(15, 99) = .893$, $p = .574$.

Discussion

In order to gain the benefits of group conflict without the costs, we focus on the common, but barely researched nudging in groups. In an online experiment we addressed the social psychological dynamics in online learning groups and explored potentially influential factors for the perception of nudging, i.e. the sender, sender's past proficiency, as well as publicness of the message. The data indicated that nudging messages sent not by a team member but by the system, were perceived more positive and persuasive, improved sender impression and internal causal attribution. In line with prior research (Lucas, Gratch, King, & Morency, 2014) this indicates that a message from a human is not always equal to a message from the system and that it can be beneficial if a system instead of a fellow human delivers unpleasant messages. Contradicting our assumptions, however, internal negative emotional affect was also higher, potentially due to the fact that participants were more likely to blame themselves when the system confronted them with negative feedback. Also against our assumptions, the system messages were not perceived more impartial. Future research will need to show whether this – in the sense of the media equation (Reeves & Nass, 1996) – actually indicates that humans and machines are subject to the same person perception mechanisms or whether this result is due to different expectations towards machines and humans.

While there was no difference between highly proficient team members and the system, the system was perceived more positive compared to low proficient team members. Keeping the idiosyncrasy credit and the media equation theory in mind, participants may think of the system differently and still attribute a level of past proficiency to the system or at least attribute sufficient competences to the system to accept that it judges oneself. Alternatively, the system might have been accepted as a truly neutral evaluator who is allowed to utter feedback

just as much as a proficient peer is. In order to address these open questions, systems' error rates should be taken into account in future studies demonstrating the systems' past proficiency. Our findings further affirm some studies in educational artificial intelligence and tutoring systems. Compared to human-tutors, intelligent computer-tutoring was shown as equally and more effective independent of time and context (for review Kulik & Fletcher, 2016) and concluded as needed only if beneficial for performance and learning (Ostrander et al., 2019). However, the mere system perception and social-psychological group dynamics were disregarded.

Regarding limitations this study so far only elucidates the effect of system nudging in the artificial context of imaginary groups. Future field studies are needed in field setting and real groups to replicate the findings. A survey analysis was applied that primarily focused on perception, but behavioral data may be more promising to investigate the topic and its links to students' learning processes and outcomes. Finally, it has to be noted that all effect sizes were small.

In conclusion, having the tutor-system deliver nudges seems to be a promising solution for a specific form of group conflicts. Future research should also include and consider the system´s potential embodiment and other cues such as natural language output. The more we learn about the conditions under which negative feedback can unfold positive effects (and the messenger does not have to be shot), the better can tutoring systems be improved to support group dynamics.

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