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External and internal sources of cognitive group awareness information: Effects on perception and usage

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Abstract

Group selection or group formation is an important but difficult task in learning groups. Group awareness tools collect, transform, and present group awareness information to provide learners, but also teachers with relevant information e.g., about potential learning partners. For these educational tools, the value and usage of the provided information may depend on how it is gathered and where it ultimately comes from. In our study (*N* = 150), we thus investigate how information from different sources is perceived and ranked. In the study, information about the skills of an anonymous person in a profile was either provided by external sources (teacher assessment, knowledge test result) or internal sources (self-assessment). Results show that information from external sources is perceived as more credible and weighted higher than internal self-assessed information. No difference between information from external personal teacher assessments and external non-personal knowledge tests was found. Hence, it is worth exploring possible effects of other external ratings than teacher assessments to see if these insights are transferable to other contexts.

Keywords: Cognitive group awareness tools, Source credibility, Assessment types, Information weighting, Learning partner selection

Introduction

In social learning contexts, the choice of appropriate learning partners for oneself or others is essential. Cognitive group awareness tools can support the selection process by linking information on potential learning partners and learning content and, for example, displaying a person's skills or expertise regarding said content (Bodemer et al., 2018). However, these tools can draw on different sources from which the displayed information originates. For example, a person's skills may have been assessed by themself, by others,

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or by a more objective source such as a knowledge test. Such different sources may not only differ from each other, they may also be perceived as having different credibility, and so may the information associated with them. Differences in learners' or teachers' evaluation of these sources can have a corresponding impact on the selection and use of information and thereby affect the selection of or interaction with learning partners. In education-related group awareness tools, differences of information from internal assessments (e.g., self-assessments (SA)) compared to external assessments (personal, e.g., teacher assessments (TA); non-personal, e.g., knowledge tests (KT)) are possible information sources that need to be considered and have been used to inform group awareness tools in the past (e.g., Schnaubert & Bodemer, 2019). Expecting external non-personal knowledge tests to be perceived as the most neutral and objective source, this type of assessment constitutes a suitable reference value to compare all sources on a neutral basis.

Literature review

Group awareness information in education: The role of sources and their credibility

In educational learning scenarios, learners are commonly not on their own but supported in their learning processes by different learning partners in learning groups. As the structuring of efficient learning processes, however, depends on how a group is formed, it is essential to focus on the choice of learning partners when they need to build groups autonomously or when groups are formed with external support (by e.g., teachers, instructors etc.). When it comes to identifying appropriate and competent learning partners, the knowledge-related abilities of a potential partner might be crucial as knowing these can have positive effects on learning processes (Ollesch et al., 2021). In this context, group awareness is conceptualized as the state of being informed about characteristics of groups or group members (Bodemer & Dehler, 2011). It can be defined as "some kind of understanding or perception of characteristics of learning partners or the collaborating group" (Schnaubert & Bodemer, 2022, p. 11), and described as an information that is available and conscious to the individual group members (Bodemer et al., 2018), which underlines the fact that group awareness is indeed a concept that includes group aspects but is also very individual-related. Group awareness information can relate to social, motivational, behavioral, cognitive, or emotional aspects of a group member (Bodemer et al., 2018), although cognitive information will be object of this study. The related term teacher awareness describes a situation where a teacher knows essential information about individual group members (Smith & Kleine, 1969). Such awareness can also be seen as a type of group awareness and be crucial for the formation or selection of groups. Group

awareness tools present learner-related information for supporting learners or teachers in gaining group awareness and structuring individual and collaborative learning processes (Bodemer & Dehler, 2011; Janssen & Bodemer, 2013) in a way that can improve learning processes and outcomes (e.g., Dehler Zufferey et al., 2010; Ghadirian et al., 2016; Janssen & Bodemer, 2013).

In a (collaborative) learning context, evaluating cognitive characteristics of learners like knowledge, opinions, or competences is difficult (Bodemer & Dehler, 2011), but to select appropriate learning partners, information about a partner's or group member's knowledge seems to be necessary (Janssen & Bodemer, 2013). The available information about a potential learning partner for learners and teachers is often limited. Therefore, a variety of cognitive group awareness tools has been developed that provide information about relevant knowledge-related characteristics of potential learning or group partners (e.g., their competences). In empirical studies, these tools not only showed the potential to support collaborative learning processes (Bodemer et al., 2018), but are also assumed to facilitate finding well-suited learning partners for a learning group or for academic help-seeking (e.g., Schlusche et al., 2021).

Even though group awareness tools are a useful medium to support structuring learning processes or choosing a learning partner, the provided group information needs to be gathered and presented in an appropriate and reliable way. In general, group awareness tools process learner-related information in three steps by collecting, transforming, and presenting learner-related data (Bodemer et al., 2018; Buder & Bodemer, 2008). Influencing the effectiveness of group awareness tools as suitable support, the actual usage of these tools is crucial (Janssen et al., 2011) – either by learners or by teachers. Whenever information is provided, learners or teachers who are forming a group need to estimate its value to decide if this information presented (e.g., the competence level of a group member) is beneficial and can be used for choosing a sufficient learning partner, forming a group, or getting specific help in groups. Thus, during these evaluation processes, the value and reliability of a given piece of information needs to be judged.

Source credibility and information weighting

The exact approach of how the value of information is evaluated is rather unclear. It may depend on the source of the information in question, making source credibility an important concept for group awareness and teacher awareness research. Source credibility is often described by the two dimensions trustworthiness and expertise (Hovland & Weiss, 1951; Ohanian, 1990), occasionally extended by the dimension of attractiveness (Ohanian, 1990). Evaluating the credibility of a source, individual source characteristics are estimated (Fogg & Tseng, 1999). Looking at this is essential as e.g., highly credible sources were shown to increase the acceptance of a message (Wolf et al., 2012). When focusing on the provision

of information about potential learning partners in social settings, it is important to clearly distinguish between the source of information about a learning partner and the learning partners themselves. This distinction becomes apparent when it comes to self-assessments, where a person is source and to-be-assessed-person at the same time.

While sources of group awareness information may differ in the actual accuracy of information they provide, it is also important to understand how this is perceived by tool users. Thus, the question arises which source's information might carry more weight for individuals who are forming or selecting a group. This perspective is important, as the actual usage of these tools might depend on the acceptance of the information source of the tool which in turn might depend on its credibility. When it comes to the design of group awareness tools in educational contexts, it is required to sensibly decide upon a specific source as input for the tool being aware of its possible influencing characteristics and role. The weighting and reliability of information including source credibility is paramount to identify credible information in group awareness tools (Taraborelli, 2008; Umeogu, 2012).

The result of this whole process of evaluating a piece of information based on its source is hereafter termed as 'information weighting'. The value of information is thereby assigned by each individual and there might be differences in terms of the included dimensions when weighting this information. It is thus important to focus the question whether the source of certain group awareness information in a tool – e.g., regarding the competence level of possible learning partners – is a relevant dimension when it comes to evaluating the value of such information within an awareness tool. Hence, evaluating the origin or source of provided information and determining its truthfulness or reliability is a central element when it comes to group awareness tools in general, but especially in educational settings where, e.g., finding appropriate learning partners or group members, seeking for help, or enhancing communication with group members is of main importance.

Types of sources: How to assess expertise in education

The accuracy of assessments might be perceived differently for external and internal sources with internal sources (e.g., self-assessments) assumingly being more subjective. While internal sources are clearly placed within the individual being assessed, external sources may vary considerably, and one may distinguish between external personal (e.g., teacher assessments) and external non-personal sources (e.g., knowledge tests). Internal self-assessments and external (personal, or non-personal) assessments have always been an important part of learning scenarios. For example, Chou and Zou (2020) investigated benefits of internal monitoring processes for self-regulated learning and external feedback finding that these are beneficial for most students but still ineffective for some. The accuracy of these assessments might hence as well be perceived differently. In this study, we combine research insights on external and internal assessments, and insights from

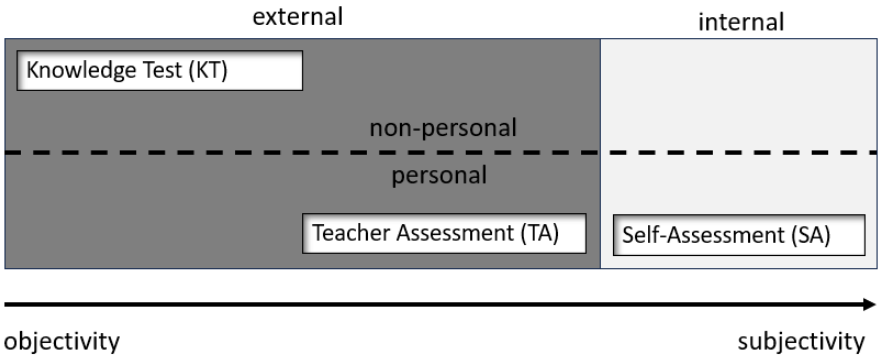


Fig. 1 Representative selection of typical assessment types as sources

personal and non-personal research to investigate the perception of representative assessment types that might occur in learning processes. See Figure 1 for the assumptions on a selection of representative assessment types that were made for this study. This does not reflect all assessment types that learners – especially students – might experience across their learning paths in education but represents a selection of mostly common assessment types for learners.

When collecting information for group awareness tools, there is a multitude of different ways to gather these data (Schnaubert et al., 2020). While external assessments are more varied with different possible sources, internal assessments only provide self-assessments where source and to-be-assessed person are identical. Internal self-assessment, however, is a rather common and easy-to-implement way to collect learner data (e.g., Dehler et al., 2011). Asking learners to gather data on their own (e.g., by asking for metacognitive self-evaluations) might increase the acceptability of such information as its sources are the learners themselves (Engelmann et al., 2009) thereby assisting learners to foster their own metacognitive regulation processes (Schnaubert & Bodemer, 2019). Such monitoring processes can have positive effects on learning outcomes (e.g., Kornell & Metcalfe, 2006; Nelson et al., 1994). De Grez et al. (2012) determined involvement to be a crucial factor for evaluations in educational contexts. Involvement seems to have a beneficial effect on the acceptance of information as e.g., learners are assumed to accept internal self-assessments to a higher extent being able to relate to the origin of the assessment (Schnaubert & Bodemer, 2019). Whilst internal self-assessments may represent a beneficial depiction of own performances as they possibly result in conscientiousness for one's own knowledge (e.g., Dunning et al., 2004; Falchikov & Boud, 1989), many researchers demonstrated self-assessments to be only weakly correlated to actual performances (Chevalier et al., 2009; Dunning et al., 2004) or to other assessments as for example to external personal teacher assessments (Chemers et al., 2001). Internal self-

assessments (as well as external peer-assessments) have been implemented increasingly in higher education over the last decades (Segers et al., 2003).

External assessments in contrast to internal self-assessments can be differentiated in external personal assessments (from e.g., peers, teachers, or professors) as well as external non-personal assessments (as e.g., tests, exams, or reports). In educational contexts, teachers may be the most informed assessors as they are able to include a variety of different aspects in their assessments whilst non-personal sources are rather limited regarding their included content for assessments. In this context, teacher assessments are still a commonly used assessment measure, especially in higher education settings, as teachers provide a wider picture (Nicol & Macfarlane-Dick, 2006). Teachers very often know their students over a longer period including multilateral aspects into their evaluation but may also be perceived as biased (Krolak-Schwerdt et al., 2013). On the other hand, carefully designed cognitive tests, that are indeed assumed to give objective measure of ability, skill, or knowledge (Feron et al., 2016), often provide only a snapshot of performance. In general, cognitive tests are a widely used method for measuring performances in educational contexts (Feron et al., 2016).

Deriving from highly credible sources (Albright & Levy, 1995) or sources with high expertise (Stone et al., 1984), external feedback is generally perceived as more accurate. However, it is interesting to see how sources might be evaluated if the actual expertise and credibility are undetermined. Focusing on different contexts, external sources were demonstrated to be important feasible feedback sources in learning (Bastarrica & Simmonds, 2019; Falchikov, 1995) but also in business environments (Harris & Schaubroeck, 1988) that are worth to be considered more detailed in research. Investigating influencing factors, a more detailed analysis of the perception of information and its source within group awareness tools is required to see if and how they influence source credibility, the information weighting and thereby the usage and efficacy of such tools for learning purposes. Thus, there is reason to assume that the perception or evaluation of information within group awareness tools differs between those sources - especially with regard to the dimensions of objectivity and subjectivity. Comparing teacher assessments and self-assessments, De Grez et al. (2012) identified that both seem to rate differently (examined in a scenario where oral presentations were rated). Even though there was a partial level of agreement, self-assessments (as well as peer assessments) were found to lead to higher marks compared to teacher assessments. Based on these findings, it is assumed that due to the very diverse ratings of teacher, peer, and self-assessments, also the perception of these assessments might be different from learner to learner.

Research question and hypotheses

The aim of the current study is to examine the perception and usage of information in group awareness tools depending on its particular source. We thereby combine research on information from internal and external perspectives, as well as from personal and non-personal sources. While investigating representative sources that might occur especially in a learning environment, we aim to identify differences in the weighting as well as the credibility of these sources to answer the question: How does the choice of the information source in a tool influence the perception and usage of the information? This may not only help us to understand tool usage but also inform tool design.

Information weighting

We hypothesized that firstly, when being compared, information from external sources (TA, KT) is weighted higher than information from internal sources (SA) (H1). Secondly, information from external personal assessments (TA) is weighted less than results from an external non-personal assessment (KT) (H2). However, when using internal self-assessments as possible sources of group awareness information, it is important to mind the fact that those estimations are very often quite biased leading to misestimations or weak information (e.g., Feld et al., 2017; Kruger & Dunning, 1999) as well as possibly being perceived quite subjectively. As a commonly used assessment measure, external non-personal cognitive tests seem to offer a substantially more objective assessment. In contrast to such non-personal tests, personal teacher assessments might provide a broader picture of performance estimation as they might know students over a period including diverse evaluation criteria and being a common assessments method. However, also external personal teacher assessments might be perceived in a biased manner to some extent.

Source credibility

Summarizing these considerations, we expect a ranking order of those assessment types for source credibility and information weighting. In this order, we generally assume external sources to be perceived as more credible compared to internal sources whereby there is a second ranking within external sources with non-personal sources (e.g., cognitive tests) to be perceived as the most credible and highest weighted source, followed by external personal sources (e.g., teacher assessments). Overall, we assume potentially subjective internal assessments (e.g., self-assessments) to be the least weighted source with less credibility than the other sources. We hence hypothesized that external assessments (TA) are perceived to have a higher source credibility than internal assessments (SA) (H3).

Methods

To test the formulated hypotheses, an online study (study ID: psychmeth_2020_SC01_08) with assessment types as within-subject factors was conducted. With a sample size of N = 150 participants (103 females, 45 males, and 2 not assigned) and a mean age of M = 27.84 (SD = 9.09), the dependent variables source credibility and the information weighting were measured. The online study was shared via social media and SurveyCircle. Participants did not receive any compensation and needed 17 minutes on average to complete the study. 68% of the participants were students (mean age of M = 24.12, SD = 3.69), 31% of the participants were employees (mean age of M = 30.34, SD = 6.40). However, 57% of the non-student participants also reported having an academic degree and thus some kind of experience in higher educational settings. Additionally, 61% of the participants did not have any experience with forming or leading groups. The study was approved by the local Ethics Committee (reference ID: 2005PFFL6217).

In an online setting, participants were asked to choose an appropriate group member for a collaborative online learning setting not for their own, but for an existing learning group. To make our study available for a broader group of people, in this scenario, participants did not need to be learners but took the role of a seminar leader with the task to choose the best (anonymous) candidate to complete an existing learning group. They did not collaborate with each other but chose from fictional learner profiles. These anonymized profiles of potential learners additionally provided cognitive group awareness information about partners' estimated competence level (1 (low) to 15 (high)), additionally showing the internal or external source of this assessment (internal: self-assessment, external: knowledge test (non-personal) or teacher assessment (personal)). Assuming knowledge tests – as external non-personal source – to be the most neutral source in our setting, knowledge test results were considered as potentially neutral reference value as the output of such a knowledge test will remain the same if the input is identical. In our study, knowledge test profiles on the left were kept at a steady reference value of 8, the profiles on the right provided competence levels either from self-assessments or from teacher assessments (see Figure 2). The competence levels changed for the right-side profiles following a particular adaptive testing approach explained below.

Assuming participants prefer group members with higher competence levels, this scenario allows to understand how participants weight information in a setting of group or teacher awareness based on the source of said information. After completing a sample question to become familiar with the type of task, participants were introduced to a learning scenario where they had to choose a learner for an existing learning group. For this purpose, anonymized profiles of potential learning partners were provided – no personal information like name, age or gender was shared (see Figure 2).

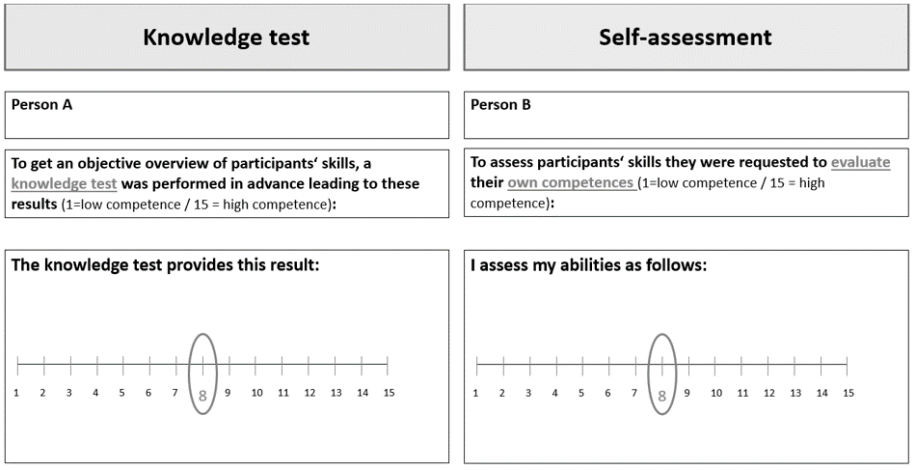


Fig. 2 Comparison of profiles

Adaptive study design

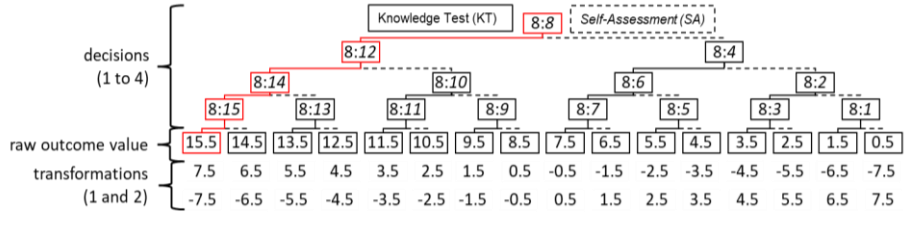
An adaptive approach was designed to maximize information gain with every decision and thus allowed to get information about participants' information weighting based on 4 comparisons per round. In the first round, participants were requested to choose between two profiles of potential learning partners both indicating a medium competency level (8 on a scale from 1 to 15). One competence estimation (left profile) was thereby said to be based on a knowledge test and the other one (right profile) was said to be based on the learner's self-assessment. With each decision, the self-assessment value was adjusted based on the decision the participants had made to maximize information gain per decision. Whenever a participant chose the profile based on the knowledge test competence estimation, the value of the self-assessed competence estimation was increased for the next decision as it was assumed that a lower self-assessment would be unlikely to be more convincing. Whenever a participant chose the profile based on the self-assessed competence estimation, the value of the self-assessed competence estimation was decreased for the next decision. The knowledge test value was kept steady at 8 throughout all trials to use it as neutral reference value. This procedure was repeated using teacher assessment as comparison.

The increase or decrease of the self-assessed or teacher-assessed competence estimation was designed to maximize the information gain for each decision using a fixed-branched adaptive algorithm (Frey, 2008). Using an adaptive testing approach, consequently, reduces testing time for participants which is an enormous advantage, especially in an online study. In addition, it allows a very individualistic approach for each participant instead of a rather general design where all participants would need to assess all profiles.

The decision tree is depicted in Figure 3. After completing the decision tree, participants ended up at an outcome value between 0.5 and 15.5. These values represent an assumed competence level that might be needed to make a participant change from being convinced by one source to another source. The value thereby can be used to quantify the weighting of self-assessed competence estimations in comparison to a knowledge test.

Following the drafted decision tree, participants received profiles depending on their individual decisions meaning that participants did not conduct the exact same study. Whilst the first decision tree compared knowledge test (KT) results to information from self-assessments (SA), the second round included comparisons of knowledge tests (KT) and teacher assessments (TA). Finally, participants repeated the first decision tree to check retest reliability testing if their results would be largely identical to the decisions they made initially. The possibility of discretionary results was thereby reduced. Both, a test for Spearman correlation ($r(148) = .71$, $p < .001$) as well as a Wilcoxon signed-rank test ($r = -.02$, $z = -.19$, $p = .426$, both $Mdn = -7.5$), were performed for this purpose. Spearman correlation showed that high values for the first decision tree for self-assessment are accompanied by high values for the later retested decision tree for self-assessment. Wilcoxon showed no significant difference between the medians of both decision trees. Both tests verified the assumption that participants did not respond arbitrarily and point towards a minimum of reliability of the values so that results could be utilized furthermore using responses from the first decision tree for all analyses with self-assessments.

After completing all three decision trees, participants were requested to complete a 6-item questionnaire for each source (teacher assessment, and self-assessment) and competence level (1, 8, 15) to be answered on a 7-point equidistant scale ($\alpha = .93$). The items were based on a questionnaire measuring source credibility by Gierl et al. (1997) and asked if the source was competent, experienced, qualified, trustworthy, honest, and selfish. To avoid participants drawing conclusions from the profile and the competence level instead of the source itself, each source (self-assessment and teacher assessment) was



Note: participants make 4 decisions: first between profile with KT (8) and SA (8) [decision 1], second between profile with KT (8) and SA (12, or 4) [decision 2], third between profile with KT (8) and SA (14, 10, 6, or 2) [decision 3], fourth between profile with KT (8) and SA (15, 13, 11, 9, 7, 5, 3, or 1) [decision 4]; raw values are then transformed in transformation 1 (centering) and 2 (inversion).

Fig. 3 Example of a decision tree (knowledge test vs. self-assessment)

provided at three different competence levels (1, 8 and 15) taking a mean source credibility for later analyses.

Example: The participant whose decisions are exemplarily shown in Figure 3 finishes the decision tree at an outcome value of 15.5. In a scenario with a medium competence estimation, this participant preferred the knowledge test for each decision independent from the self-assessed competence level of the to-be-assessed-person. In this concrete example, it can be assumed that an anonymized profile with information from a self-assessment needs a competence level of more than 15 (which is demonstrated by the theoretical value of 15.5) to be weighted more than the medium knowledge test result of 8 by our example participant here. Any assessed person with a competence level of lower than 15 could not convince the participant in our example which leads to the assumption that a competence level of higher than 15 is needed at minimum (demonstrated by a theoretical value of 15.5).

If a participant ends up at a score of 13.5, a self-assessed competence level between 13 and 14 (represented by 13.5) will alter the participant's vote in favor of this person in comparison to a person with a knowledge test-based competence estimation of 8.

Transformation of decision tree outcome

After completing the decisions tasks, participants end up at a score as depicted in the lowest boxes of each decision tree (see Figure 3). This outcome represents the minimum competence level required by the alternative (personal) source (self- or teacher assessment) to outperform a hypothetical score of 8 gained from a knowledge test. This means that any score higher than 8 indicates that participants weight the knowledge test information higher than information from an alternative source. Conversely, a score lower than 8 demonstrates that participants give more weight to the provided competence information from the alternative source.

Gathering all outcome values, the comparison value for knowledge tests will always remain the same (value: 8), whereas the other variables show the information weighting from a self-assessment in comparison to a knowledge test or the information from a teacher assessment in comparison to a knowledge test (see Figure 3). We transformed the values to make them easier to understand. First, we conducted a linear transformation by deducting eight thereby re-fixing the scale on a mean value of 0 (instead of 8). In a second step, we recoded the values so that negative values indicate lower and positive values higher information weighting in comparison to the knowledge test as a more intuitive coding. Altogether, the transformation was value(new) = (value(old) – 8) * -1.

Results

General findings

We checked the prerequisites for further analyses testing for normal distributions to see if parametric or non-parametric tests could be performed. Testing the assumption of normal distribution for source credibility and information weighting, most of the variables were not normally distributed (Shapiro Wilk tests; Table 1).

As outliers play a key role in terms of content, they have intentionally been included in all calculations. If a participant continuously chooses a certain source (knowledge test results (KT), information from self-assessments (SA) or information from teacher assessments (TA)), this is not to be considered as statistical outlier but may be an important aspect for our analyses demonstrating that this individual is strongly convinced by the information from this specific source.

Normality assumptions were violated for dependent variables. It was hence decided to use non-parametric tests for dependent data for all further analyses (Wilcoxon signed-rank test, one-sample Wilcoxon test, Spearman correlations). The descriptive statistics of the variables are shown in Table 2.

To test hypotheses 1 and 2, it was examined if information weighting from either teacher assessment or self-assessment deviates from the value 0 which represents no difference between a source (teacher assessment or self-assessment) and results from a knowledge test (one-sample Wilcoxon test; applying Helmert contrasts was not appropriate as all knowledge test values were set to a reference value of 0 resulting in only two varying values). Whereas H1 confirmed that information from self-assessments is given significantly less weight than results from a knowledge test ($Mdn = -7.5$, $IQR = 5$, $z = -8.13$, $p = <.001$; $r = -.66$), there was no significant difference between the information

Table 1 Shapiro-wilk tests for normality assumptions

Source Credibility			Information Weighting		
Variable	*p*	*W*	Variable	*p*	*W*
TA	**.003**	**0.971**	TA	**<.001**	**0.724**
SA	.053	0.983	SA	**<.001**	**0.937**
			SA (retest)	**<.001**	**0.787**

Table 2 Descriptive statistics

Variable	Information Weighting		Source Credibility	
	Mdn	*IQR*	*Mdn*	*IQR*
SA	-7.5	5	3.56	1.10
TA	.5	4	5.11	1.82

weighting from teacher assessments and from knowledge tests (H2) with information from teacher assessments even being weight slightly stronger (*Mdn* = .5, *IQR* = 4, $z = -.93$, $p = .176$; $r = -.08$). It was assumed that information from teacher assessments is weighted more compared to information from self-assessments in a direct confrontation with knowledge test results (H1). To test this hypothesis, a non-parametric Wilcoxon signed-rank test was conducted finding a strong effect ($z = -7.25$, $p = <.001$, $r = -.59$) for the difference between the information weighting of teacher assessments (*Mdn* = .5, *IQR* = 4) and self-assessments (*Mdn* = −7.5, *IQR* = 5).

To compare the source credibility of teacher assessments and self-assessments for H3, another Wilcoxon signed-rank test was performed demonstrating a strong effect ($r = -.66$, $p = <.001$). Teacher assessments (*Mdn* = 5.11, *IQR* = 1.82) were shown to be perceived as significantly more credible than self-assessments (*Mdn* = 3.56, *IQR* = 1.10) confirming H3 ($z = -8.13$, $p = <.001$). As an additional analysis, different Spearman correlations were calculated. In this context, it was examined if there is a correlation between the information weighting from self-assessments and their source credibility detecting only a weak correlation ($r(148) = .22$, $p = .007$). The correlation between the information weighting from teacher assessments and the source credibility of teacher assessments was also found to be weak ($r(148) = .19$, $p = .002$).

Discussion

Interpretation of results

Our results indicate that individuals weight information from external sources for their decision for a learning partner in a group higher than information from internal sources. Focusing on external sources only, we could not identify a major difference for external personal teacher assessments compared to external non-personal knowledge tests which is surprising at first glance. Indeed, Feron et al. (2016) found teacher assessments to be twice as important as cognitive test results (for initial track placement in secondary school). In addition, we found participants to give significantly more weight to information from external teacher assessments than they give to information from internal self-assessments confirming our second hypothesis. The fact that self-assessments are commonly expected to be biased to some extent might be a possible explanation for this finding. With people often misestimating their performances (Feld et al., 2017; Kruger & Dunning, 1999), people who are confronted with self-assessed information might be suspicious about the quality of the given information. Consistent with this finding, it could be determined that self-assessments are weighted significantly lower compared to results from a knowledge test.

Even if the scenario was very specific and different compared to our settings, – as Feron et al. (2016) examined track placement in secondary schools – the findings are valuable indications of how important further studies about the contrasts of teacher assessments and knowledge tests might be. Although we assumed that knowledge tests provide more objective information than a personal source, information from teacher assessments were not given significantly more or less weight in our study contradicting our assumed ranking of sources. While a test usually includes only a predefined set of questions, teachers might create a more versatile performance estimation including different performance indicators in their assessments. Information from teachers might be perceived as less credible than neutral knowledge tests. However, as knowledge tests have only been used as objective reference value for our comparisons, it is not possible to further reflect on these assumptions without additional studies. The results confirm our overall assumption that there is a perceived ranking order of these sources manifesting in differently perceived credibility of the provided information by each source. Leaning on metacognitive research, it seems to be reasonable that self-assessments are rather avoided when participants are striving to get suitable information on learning partners for a group. Whilst we expected self-assessment information to be seen critical as it can be quite biased (Feld et al., 2017; Kruger & Dunning, 1999), it is interesting to detect no significant difference between teacher assessments and knowledge test results. Interestingly, self-assessments might provide a decisive advantage in contrast to teacher assessments. Even though a teacher knows students over a period collecting versatile information regarding the performance or abilities of a student, self-assessments are expected to usually reach higher acceptances of learners as learners themselves are providing the relevant information (Schnaubert & Bodemer, 2019). There is thus an intuitive understanding and control of the information provided by the data provider. Nonetheless, information from self-assessments was weighted less compared to both teacher assessments and knowledge test results.

In terms of source credibility, it was examined if teacher assessments – being weighted more preferably – show a higher source credibility as well. We assumed that the information weighting and the credibility of a source are related as one aspect might implicitly influence the other one. If a high credibility is assigned to a source, the provided information and hence related credibility might also be perceived positively as opposed to low credible perceived sources. Our analyses only partially confirmed this hypothesis.

Whereas we could clearly determine teacher assessments to be perceived as significantly more credible compared to self-assessments, the information weighting and the credibility of its respective source were only weakly correlated for both teacher assessments and self-assessments. Although there are differences in the perception of source credibility, this contrast might not directly impact the information weighting. There might be something else than the source credibility influencing how information from a source is weighted as

e.g., the gender of a source. When investigating gender effects in terms of sources and their credibility, study results are very versatile either finding women to be less credible compared to men (e.g., Nagle et al., 2014), or being more credible than men (Bigham et al., 2019). There are also research studies constituting quite versatile results for possible gender effects (Todd & Melancon, 2018). In addition, the (assessed) competence level might be of interest as, for example, over- and underestimation of individuals is perceived differently. If high performers tend to under- and low performers overestimate their achievements (Kruger & Dunning, 1999), we assume that competence levels might influence both source credibility and the information weighting.

The specific scenario might have influenced how source credibility affected the usage of the provided information considering that no context information except from the profiles themselves was provided – neither for the task, the learning partner, the existing group, nor the source itself (e.g., specific information about the teacher). While this design was chosen to increase internal validity, this lack of contextual information might have compromised the relationship between credibility – assigned to a rather abstract and unknown source – and the weight put upon the information of that source (see Limitations).

Summarizing all these findings and their implications, we could demonstrate the source to be a pivotal aspect when it comes to the provision of information within group awareness tools especially considering that tools can improve learning processes and outcomes (Ghadirian et al., 2016). The different information weighting depending on the source needs to be considered when choosing which information is to be provided within group awareness tools. Engelmann et al. (2009) found an increased acceptability of self-assessed information – as the source is often the learner himself knowing where this information results from. This might indeed be a relevant aspect when self-assessed information is used by learners. However, in our scenario, self-assessed information was used by an external person. Even though information that is given based on self-assessments is potentially perceived authentically by learners themselves, our study demonstrated that this self-assessed information might be perceived as less reliable by other learners, teachers, or seminar leaders that work with such tools. These differences in perspective between data providers themselves and data clients receiving the information stress the intricate nature of group awareness tools and sets it apart from other educational tools based on learner data as one of the key features of these tools is that the target population incorporates both perspectives (Schnaubert & Bodemer, 2019). Furthermore, it is interesting to consider the role of teacher assessments within group awareness tools. Especially in a context of educationally used online tools, teachers and their assessments of students often play a significant role being a common measure of performance in higher education. However, finding no relevant difference between teacher assessments and knowledge test results, it is worth considering if it is even necessary to distinguish between these two sources or if

it is sufficient for any group awareness tool to make use of only one of these sources. It is furthermore conceivable that results might differ if the teacher assessment comes from a teacher that is known instead of an entirely anonymous teacher. Similarly, a specific and known test might be perceived as more or less validly portraying learner competence. Additionally, when communication and assessments are computer-mediated, it is of main importance to ensure that individuals trust the provided data as this might be a critical aspect in terms of the usage of the tool. It might simply be decided not to use a tool or trust the presented information from a tool if tool users do not rate it as useful and trustworthy. We could demonstrate that the source plays a paramount role in tools, influencing how not only the source itself but the provided information is perceived. As this perception of information, however, is pivotal for the functioning of the tool, it needs to be considered if a source is consciously presented in a tool. As there is, additionally, no sensorial information in such tools, the question of how data is perceived becomes even more critical.

Limitations

Even though this study provided fruitful insights, some limitations of this work need to be considered. Focusing on the study design, the explanatory power of some results is limited as our variables could only take a quite small range of possible values. With values from −7.5 to 7.5 and with intermediate steps of .5, there are not too many possible forms that our values could have. As these values are furthermore undefined and theoretical ranges, analyses and interpretation for these values are limited to some extent. In addition, it needs to be considered that participants conducted a study in an artificially created, rather theoretical, scenario. In the created scenario, the available information was limited whilst participants were forced to choose one of the profiles from the perspective of a seminar leader. While this was done to decrease noise and increase internal validity, in a more authentic setting, learners might possibly decide not to choose any of the profiles or try to gather more information about the profiles or the sources providing the assessment for each profile. The adaptive testing scenario that was used reduced testing time for participants which was crucial in our setting as it was conducted as online study. In addition, it allowed a very individualistic approach for each participant instead of a rather general design.

The high degree of variability of participants offers chances and limitations, concurrently. 68% of the participants were students that are quite familiar with learning scenarios even in a theoretically created online scenario where they do not know the other (fictive) learners. Even though, the remaining 32% were employees or other professions (as e.g., retirees, unemployed or self-employed), 57% of these participants reported to have an academic degree, assuming that participants might easily be able to put themselves into the setting of this study. No gender prerequisites were defined for this study. Nevertheless, with a ratio of 2.3:1, our study was predominantly conducted by female participants. This might be due

to different usage of our online distribution channels, e.g., SurveyCircle. While we have no indications that gender has an effect on the study processes, we cannot exclude that our gender rate has affected the results. As we conducted the study in an online setting, the instructions and conditions were strongly prescribed limiting the generalizability of the findings towards more complex and authentic decision scenarios in higher education.

Implications, conclusions, and outlook

This study could show sources to be pivotal parameters whenever information needs to be evaluated to some extent. As the assessment, perception, and usage of information, in turn, is a crucial aspect of educational group awareness tools, the meaning of sources in this context even increases. Especially in computer-mediated scenarios, learners, teachers, seminar leaders etc. need to rely on whatever tools and resources are available. As in real-world settings, people base their decisions on personal perceptions and experiences, the reduced information density in group awareness tools requires an even more focused consideration of key aspects that might assist individuals improving the usage and design of such tools. The source of information might influence if and how information is used by group members. According to Kwon (2020) who examined the effects of student-generated group awareness information in tools, such information can be trustworthy and advantageous when students are guided appropriately. It is hence worth pondering if not only self-assessments, teacher assessments or knowledge tests, but also some kind of peer assessments are an insightful possible approach for future research.

Rains (2007) found anonymity in computer-mediated group communication to be a negative aspect undermining source credibility. It might, hence, be interesting to see if an anonymous source in our setting (or even the absence of a source) might influence our results to some extent. It is also conceivable that learners do not consider the source of an information if they are not explicitly asked to pay attention to a source or even feel distracted from the additional data about the origin of an information.

Another possibly relevant implication of our study could be a generalization of teacher assessments. In our study, teacher assessments (apart from the knowledge tests that were used, however, only as references) were the only sort of external feedback that was used. However, not only in educational, but also in professional or even private settings, there are even more types of external assessments.

Even though Nicol and Macfarlane-Dick (2006) found teacher assessments to be a quite common and widely used assessment method in higher education, future research could further investigate the explicit role of knowledge tests in this context, as these were only used as a neutral reference value and thus were only indirectly included in our analyses. Besides, it is worth examining the actual characteristics of teacher assessments in more detail to see if they differ from knowledge tests in any manner. It might hence be central

to see if (and how) the perception of teacher assessment changes when they are known to learners instead of being anonymous. As we could find no significant difference between information weighting from knowledge tests and information from teacher assessments, we need to explore in more detail, if it is even necessary to differentiate between these two external assessment types. In specific scenarios, it might be interesting and reasonable to use either teacher assessments or knowledge tests as both seem to be perceived similarly.

Abbreviations
SA: Self-Assessment; TA: Teacher Assessment; KT: Knowledge Test.

Authors' contributions
All authors have made substantial contributions to the work. LJF planned and conducted the study and wrote the manuscript. DB and LS supported in all stages and contributed to article writing. All authors read and approved the final version of the manuscript.

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References
Albright, M. D., & Levy, P. E. (1995). The effects of source credibility and performance rating discrepancy on reactions to multiple raters. *Journal of Applied Social Psychology*, *25*(7), 577–600. https://doi.org/10.1111/j.1559-1816.1995.tb01600.x

Bastarrica, M. C., & Simmonds, J. (2019, May). Gender differences in self and peer assessment in a software engineering capstone course. In *Proceedings of IEEE/ACM 2nd International Workshop on Gender Equality in Software Engineering* (pp. 29–32). IEEE. https://doi.org/10.1109/GE.2019.00014

Bigham, A., Meyers, C., Li, N., & Irlbeck, E. (2019). The effect of emphasizing credibility elements and the role of source gender on perceptions of source credibility. *Journal of Applied Communications*, *103*(2). https://doi.org/10.4148/1051-0834.2270

Bodemer, D., & Dehler, J. (2011). Group awareness in CSCL environments. *Computers in Human Behavior*, *27*(3), 1043–1045. https://doi.org/10.1016/j.chb.2010.07.014

Bodemer, D., Janssen, J., & Schnaubert, L. (2018). Group awareness tools for computer-supported collaborative learning. In F. Fischer, C. E. Hmelo-Silver, S. R. Goldman & P. Reimann (Eds.), *International handbook of the learning sciences* (pp. 351–358). Routledge. https://doi.org/10.4324/9781315617572

Buder, J., & Bodemer, D. (2008). Supporting controversial CSCL discussions with augmented group awareness tools. *International Journal of Computer-Supported Collaborative Learning*, *3*(2), 123–139. https://doi.org/10.1007/s11412-008-9037-5

Chemers, M. M., Hu, L. T., & Garcia, B. F. (2001). Academic self-efficacy and first year college student performance and adjustment. *Journal of Educational Psychology*, *93*(1), 55–64. https://doi.org/10.1037/0022-0663.93.1.55

Chevalier, A., Gibbons, S., Thorpe, A., Snell, M., & Hoskins, S. (2009). Students' academic self-perception. *Economics of Education Review*, *28*(6), 716–727. https://doi.org/10.1016/j.econedurev.2009.06.007

Chou, C.-Y., & Zou, N.-B. (2020). An analysis of internal and external feedback in self-regulated learning activities mediated by self-regulated learning tools and open learner models. *International Journal of Educational Technology in Higher Education*, *17*(1), 1–27. https://doi.org/10.1186/s41239-020-00233-y

De Grez, L., Valcke, M., & Roozen, I. (2012). How effective are self- and peer assessment of oral presentation skills compared to teachers' assessments? *Active Learning in Higher Education*, *13*(2), 129–142. https://doi.org/10.1177/1469787412441284

Dehler, J., Bodemer, D., Buder, J., & Hesse, F. (2011). Guiding knowledge communication in CSCL via group knowledge awareness. *Computers in Human Behavior*, *27*(3), 1068–1078. https://doi.org/10.1016/j.chb.2010.05.018

Dehler Zufferey, J., Bodemer, D., Buder, J., & Hesse, F. W. (2010). Partner knowledge awareness in knowledge communication: Learning by adapting to the partner. *The Journal of Experimental Education*, *79*(1), 102–125. https://doi.org/10.1080/00220970903292991

Dunning, D., Heath, C., & Suls, J. M. (2004). Flawed self-assessment: Implications for health, education, and the workplace. *Psychological Science in the Public Interest: A Journal of the American Psychological Society*, *5*(3), 69–106. https://doi.org/10.1111/j.1529-1006.2004.00018.x

Engelmann, T., Dehler, J., Bodemer, D., & Buder, J. (2009). Knowledge awareness in CSCL: A psychological perspective. *Computers in Human Behavior*, *25*(4), 949–960. https://doi.org/10.1016/j.chb.2009.04.004

Falchikov, N. (1995). Peer feedback marking: Developing peer assessment. *Innovations in Education and Training International*, *32*(2), 175–187. https://doi.org/10.1080/1355800950320212

Falchikov, N., & Boud, D. (1989). Student self-assessment in higher education: A meta-analysis. *Review of Educational Research*, *59*(4), 395–430. https://doi.org/10.3102/00346543059004395

Feld, J., Sauermann, J., & de Grip, A. (2017). Estimating the relationship between skill and overconfidence. *Journal of Behavioral and Experimental Economics*, *68,* 18–24. https://doi.org/10.1016/j.socec.2017.03.002

Feron, E., Schils, T., & ter Weel, B. (2016). Does the teacher beat the test? The value of the teacher's assessment in predicting student ability. *De Economist*, *164*(4), 391–418. https://doi.org/10.1007/s10645-016-9278-z

Fogg, B. J., & Tseng, H. (1999). The elements of computer credibility. In M. G. Williams & M. W. Altom (Eds.), *CHI'99 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 80–87). ACM. https://doi.org/10.1145/302979.303001

Frey, A. (2008). Adaptives testen. In H. Moosbrugger & A. Kelava (Eds.), *Testtheorie und Fragebogenkonstruktion* (pp. 261–278). Springer. https://doi.org/10.1007/978-3-540-71635-8_11

Ghadirian, H., Ayub, A. F. M., Silong, A. D., Bakar, K. B. A., & Hosseinzadeh, M. (2016). Group awareness in computer-supported collaborative learning environments. *International Education Studies, 9*(2), 120–131. https://doi.org/10.5539/ies.v9n2p120

Gierl, H., Stich, A., & Strohmayr, M. (1997). Einfluß der Glaubwürdigkeit einer Informationsquelle auf die Glaubwürdigkeit der Information. *Marketing: ZFP – Journal of Research and Management*, *1*, 27–31. https://doi.org/10.15358/0344-1369-1997-1-27

Harris, M. M., & Schaubroeck, J. (1988). A meta-analysis of self-supervisor, self-peer, and peer-supervisor ratings. *Personnel Psychology*, *41*(1), 43–62. https://doi.org/10.1111/j.1744-6570.1988.tb00631.x

Hovland, C. I., & Weiss, W. (1951). The influence of source credibility on communication effectiveness. *Public Opinion Quarterly*, *15*(4), 635. https://doi.org/10.1086/266350

Janssen, J., & Bodemer, D. (2013). Coordinated computer-supported collaborative learning: Awareness and awareness tools. *Educational Psychologist*, *48*(1), 40–55. https://doi.org/10.1080/00461520.2012.749153

Janssen, J., Erkens, G., & Kirschner, P. A. (2011). Group awareness tools: It's what you do with it that matters. *Computers in Human Behavior*, *27*(3)*,* 1046–1058. https://doi.org/10.1016/j.chb.2010.06.002

Kornell, N., & Metcalfe, J. (2006). Study efficacy and the region of proximal learning framework. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *32*(3), 609–622. https://doi.org/10.1037/0278-7393.32.3.609

Krolak-Schwerdt, S., Böhmer, M., & Gräsel, C. (2013). The impact of accountability on teachers' assessments of student-performance: A social cognitive analysis. *Social Psychology of Education*, *16*(2), 215–239. https://doi.org/10.1007/s11218-013-9215-9

Kruger, J. & Dunning, D. (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology*, *77*(6), 1121–1134. https://doi.org/10.1037/0022-3514.77.6.1121

Kwon, K. (2020). Student-generated awareness information in a group awareness tool: What does it reveal? *Educational Technology Research and Development*, *68*, 1301–1327. https://doi.org/10.1007/s11423-019-09727-7

Nagle, J. E., Brodsky, S. L., & Weeter, K. (2014). Gender, smiling, and witness credibility in actual trials. *Behavioral Sciences and the Law*, *32,* 195–206. https://doi.org/10.1002/bsl.2112

Nelson, T. O., Dunlosky, J., Graf, A., & Narens, L. (1994). Utilization of metacognitive judgments in the allocation of study during multitrial learning. *Psychological Science*, *5*(4), 207–213. https://doi.org/10.1111/j.1467-9280.1994.tb00502.x

Nicol, D., & Macfarlance-Dick, D. (2006). Formative assessment and self-regulated learning: A model and seven principles of good feedback practice. *Studies in Higher Education*, *31*(2), 199–218. https://doi.org/10.1080/03075070600572090

Ohanian, R. (1990). Construction and validation of a scale to measure celebrity endorsers' perceived expertise, trustworthiness, and attractiveness. *Journal of Advertising*, *19*(3), 39–52. https://doi.org/10.1080/00913367.1990.10673191

Ollesch, L., Heimbuch, S., & Bodemer, D. (2021). Improving learning and writing outcomes: Influence of cognitive and behavioral group awareness tools in wikis. *International Journal of Computer-Supported Collaborative Learning*, *16*, 225–259. https://doi.org/10.1007/s11412-021-09346-6

Rains, S. A. (2007). The impact of anonymity on perceptions of source credibility and influence in computer-mediated group communication. *Communication Research*, *34*(1), 100–125. https://doi.org/10.1177/0093650206296084

Schlusche, C., Schnaubert, L., & Bodemer, D. (2021). Perceived social resources affect help-seeking and academic outcomes in the initial phase of undergraduate studies. *Frontiers Education*, *6*, 732587. https://doi.org/10.3389/feduc.2021.732587

Schnaubert, L., & Bodemer, D. (2019). Providing different types of group awareness information to guide collaborative learning. *International Journal of Computer-Supported Collaborative Learning*, *14*(1), 7–51. https://doi.org/10.1007/s11412-018-9293-y

Schnaubert, L., & Bodemer, D. (2022). Group awareness and regulation in computer-supported collaborative learning. *International Journal of Computer-Supported Collaborative Learning*, *17*(1), 11–38. https://doi.org/10.1007/s11412-022-09361-1

Schnaubert, L., Harbarth, L., & Bodemer, D. (2020). A psychological perspective on data processing in cognitive Group Awareness Tools. In M. Gresalfi & I. S. Horn (Eds.), *The Interdisciplinarity of the Learning Sciences, 14th International Conference of the Learning Sciences (ICLS) 2020, Vol. 2* (pp. 951–958). International Society of the Learning Sciences. https://repository.isls.org/handle/1/6839

Segers, M., Dochy, F., & Cascallar, E. (2003). *Optimising new modes of assessment: In search of qualities and standards.* Springer Dordrecht. https://doi.org/10.1007/0-306-48125-1

Smith, L. M., & Kleine, P. F. (1969). Teacher awareness: Social cognition in the classroom. *The School Review*, *77*(3/4), 245–256.

Stone, D. L., Gueutal, H. G., & McIntosh, B. (1984). The effects of feedback sequence and expertise of the rater on perceived feedback accuracy. *Personnel Psychology*, *37*(3), 487–506. https://doi.org/10.1111/j.1744-6570.1984.tb00525.x

Taraborelli, D. (2008). How the web is changing the way we trust. In K. Waelbers, A. Briggle & P. Brey (Eds.), *Current issues in computing and philosophy* (pp. 194–204). IOS Press.

Todd, P. R., & Melancon, J. (2018). Gender and live-streaming: Source credibility and motivation. *Journal of Research in Interactive Marketing*, *12*(1), 79–93. https://doi.org/10.1108/JRIM-05-2017-0035

Umeogu, B. (2012). Source credibility: A philosophical analysis. *Open Journal of Philosophy*, *2*(2), 112–115. https://doi.org/10.4236/ojpp.2012.22017

Wolf, A. G., Rieger, S., & Knauff, M. (2012). The effects of source trustworthiness and inference type on human belief revision. *Thinking & Reasoning*, *18*(4), 417–440. https://doi.org/10.1080/13546783.2012.677757

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