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Flexible social perspective taking in higher education and the role of contextual cues

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Abstract

Being able to coordinate the perspectives of oneself and others is likely to be helpful in educational contexts. For example, teachers need flexible social perspective taking to understand their own perspectives and those of their students. Evidence suggests that reading facilitates social perspective taking because it involves readers coordinating social perspectives. However, there is little evidence on actual flexible perspective taking in educational contexts. In the current research, we assumed that the presence of different spatial, temporal, and social cues with regard to (higher) educational contexts would affect flexible social perspective taking performances of prospective psychologists and teachers. Across two different studies, we employed relational frame theory and a within-subject design (n = 44 undergraduate students in Study 1 and n = 176 teacher education students in Study 2). We analyzed the data by Rasch-trees and general linear modeling. The results showed faster responding on flexible spatial and temporal social perspective taking tasks, involving a fictional college course in "English" rather than "statistics" (Study 1). In Study 2, the results suggested greater accuracy on flexible spatial and temporal social perspective taking tasks involving spatial rather than temporal relations (Study 2). The results shed some light on the integration of different approaches for research on understanding the relevance of flexible social perspective taking in educational contexts. Flexible spatial and temporal social perspective taking may be of benefit to both students in higher education and teachers in school education.

Keywords: *Undergraduate students; teacher education; social perspective taking; higher education; relational frame theory; spatial or temporal relational frames*

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1. Introduction

Social interactions and interpersonal understanding are core features of (collaborative) learning in higher education and in education at school. Social perspective-taking seems to be especially important for interpersonal understanding (Davis, 1980, 1983) and dealing with heterogeneous groups, cultural diversity, and inclusion in educational contexts (Wilson et al., 2017). It is perspective-taking with reference to a human(-like) target and their situation that bolsters understanding of others' behavior (Davis, 1983) by stimulating a person to establish a mental representation of a social situation (i.e., mentalizing, Engen & Singer, 2013). Social perspective-taking is an umbrella term for several forms of behavior and underlying processes rather than one specific skill (Erle & Topolinski, 2015).

Psychologists and teachers use social perspective taking extensively to respond socially-appropriate in conjunction with their professional knowledge (Gehlbach, Brinkworth, et al., 2012; Gehlbach, Young, et al., 2012). Psychologists mainly respond to one client in front of them. In contrast, teachers mainly respond to one or more students of a group in the class in school or higher education.

One problem is that teachers have to keep many things in mind including their content, pedagogical-content, and pedagogical-psychological knowledge (Gudmundsdottir & Shulman, 1987; von Aufschnaiter et al., 2015). They have to act according to their lesson preparation, as well as orientate to students' traits and states, and learning goals planned for that lesson. For example, teachers have to constructively interact with students, and react appropriately when students co-construct their learning environment in the class (Damşa, 2014; Damşa et al., 2019). Thus, teachers have to *coordinate* among themselves, their planned lesson contents, and the students. This coordination is common but subtle. Teachers may instruct students to sit in teams facing one-another to facilitate active peer-to-peer learning rather than sitting in rows facing the teacher (Wolgast, Tandler, et al., 2020; Wolgast & Oyserman, 2019).

In contrast, other teachers seem not to appreciate that students with their backs facing them see something different than the teachers (Wolgast, Tandler, et al., 2020; Wolgast & Oyserman, 2019). Who has not experienced a teacher 'standing in the picture' in front of the board for too long? If the teacher takes into account the learners' view of the board or the smartboard, they are engaging in *visuospatial social perspective taking* and can move swiftly 'out of the picture'. In other words, seeing what students see requires teacher's *visuospatial social perspective taking*. There are, however, very few published findings on factors that facilitate or impair a teacher's consideration of a student's momentary spatial position based on the student's perspective in the classroom. This *visuospatial social perspective taking* required by the teacher is a basic feature that enables them to consider another individual's angle of view (Wolgast, Tandler, et al., 2020).

This study addresses the identified gap in published findings on factors that facilitate or impair a teacher's consideration of a student's momentary spatial position in the classroom. In particular, flexible social perspective taking involving spatial relations is an under-researched branch of (higher) education (Wolgast, Tandler, et al., 2020; Wolgast & Oyserman, 2019) although it might facilitate classroom management during teaching. One reason for the under-investigation might be that this form of perspective taking is difficult to test in classrooms in higher education and school.

Our rationale was that inter-individual differences exist in this type of perspective taking in psychologists and teachers even within relatively homogeneous or heterogeneous social groups (e.g., undergraduate students and teacher education students). Moreover, we expected to observe intra-individual and inter-individual differences, depending on the presence of specific contextual cues, using tasks that had been employed in previous research (McHugh et al., 2007). The observation of such differences would contribute to existing research on the relationship between social behavior and different contexts, since these differences in flexibility may represent underlying non-observable processes in educational contexts such as teacher's classroom management and social support.

1.1 Previous research

Effective classroom management and teacher's social support (Hugener et al., 2009; Lipowsky

et al., 2009) are two dimensions of teacher's instructional quality that might require visuospatial social perspective taking. There are rarely research findings on this possible relationship. However, a consensus view from previous studies is that teacher's instructional quality may impact students' learning outcomes (Kunter et al., 2013; Lipowsky et al., 2009; Rjosk et al., 2014).

Effective classroom management involves, for example, establishing clear classroom procedures, manage transitions between lesson sequences smoothly, keep track of students' work, adapt their well-planned lessons accordingly, and intervene in students' inappropriate behavior (Evertson, 1989; Kounin, 1970; Lipowsky et al., 2009). Effective classroom management provides space and time for cognitive engagement and learning of students (Aloe et al., 2014; Korpershoek et al., 2016; Long et al., 2019). Especially for smooth transitions between lesson sequences, it is valuable to examine prospective teachers' flexible spatial and temporal social perspective taking.

Teachers often apply an individual reference norm during classes to support students (Lohbeck & Freund, 2021; Marksteiner et al., 2021; Rheinberg, 1977, 2001). When applying the individual reference norm, teachers need to make use of temporal relations to highlight, for example, a student's learning gains from yesterday to today. Teachers' social support was positively related to their *conceptual social perspective taking* (Gehlbach et al., 2016). *Conceptual social perspective* taking involves seeing and understanding another's current possible intention, aims, and resulting behavior, and this skillset bolsters our understanding of others' behavior (Gehlbach et al., 2015) by enabling us to mentalize a social situation (Engen & Singer, 2013). *Conceptual social perspective taking* is necessary for effective communication, cooperation (Johnson, 1975; Mouw et al., 2020), and socially appropriate behavior (Gehlbach, 2004; Gehlbach, Brinkworth, et al., 2012). Conceptual social perspective taking, therefore, requires that one can shift flexibly between one's own and another's viewpoint visuospatially or conceptually (i.e., to understand someone else). Some research has shown that teachers with high levels of conceptual social perspective taking are more effective as teachers (Hyun & Marshall, 1997; O'Keefe & Johnston, 1989) than those with relatively low conceptual social perspective-taking. The former might be more effective because accurately reading their students' cues allows them to adjust their interactions appropriately (Hunt, 1976).

In contrast, test anxiety in teacher education students significantly predicted relatively low levels of their conceptual social perspective taking about six months later (Wolgast, Hille, et al., 2020). There is increasing evidence of statistics test anxiety among university students in social sciences (Bourne, 2018; Onwuegbuzie, 2004; Siew et al., 2019; Zeidner, 1991). Significant differences further existed in response times on presented neutral (e.g., "plate") vs threat-related words (e.g., "cancer"), with longer response times related to threatening words (Bar-Haim et al., 2007, p. 3). This effect is known as threat-related attentional bias and is often investigated in samples with low vs high anxiety scores (Bar-Haim et al., 2007). However, the relationship between a simple cue to statistics and performance in flexible social perspective-taking tasks has not been investigated in previous research.

Teaching experiences are often assessed by self-reports within standardized inventories (Tschannen-Moran & Hoy, 2001). Teachers' self-reported behavior from complex classroom situations may be a subjective construction at a cognitive level of their cognitive/socio-emotional experiences in a lesson or, more from a bird's view at a metacognitive level, it may be a form of self-reflection. It is difficult to disentangle these two possibilities through research on basic cognitive processes in teacher education students or teachers. One approach to explore cognitive rather than metacognitive processes is to present tasks instead of using self-report items to teacher education students or teachers. One possible means of assessing these processes is to activate *core flexible spatial and temporal social perspective taking* in tasks (Barnes-Holmes et al., 2004; McHugh et al., 2004a) that are adapted to classroom situations (Willisch et al., 2021).

In the research field on social perspective taking, there are conceptualizations and findings on linguistic aspects that stimulate either flexible social perspective taking towards another person or the mental focus on oneself (Barnes-Holmes et al., 2013; McHugh et al., 2004b; Scanlon & Barnes-Holmes, 2013; Wolgast et al., 2018; Wolgast & Barnes-Holmes, 2018). For the acquisition of flexible spatial social perspective taking, for example, tasks have been used in which a person was asked to imagine two chairs and then to flexibly shift between their own point of view on the chair and another person's

view from the other chair. When the person responded to a question about sitting there instead of here, they were able to solve the tasks correctly (Barnes-Holmes et al., 2004; McHugh et al., 2004a). Furthermore, there is evidence that relations exist between flexible spatial and temporal social perspective taking in language and reality (Barnes-Holmes et al., 2013; McHugh et al., 2004b; Scanlon & Barnes-Holmes, 2013; Wolgast et al., 2018; Wolgast & Barnes-Holmes, 2018).

In summary, psychologists and teachers need social perspective taking to understand the behavior of people they work with. Different forms of social perspective taking may be distinguished. For example, teaching might be facilitated by visuospatial perspective taking when a teacher presents learning materials in such a way that all students can see the materials. Teaching and classroom management might further be related to *conceptual* social perspective taking that may be difficult within limited time frames of classroom situations. Alternatively, *flexible* spatial and temporal social perspective taking might facilitate such demands of classroom management but is difficult to assess in educational contexts with a high degree of objectivity.

The overarching aim of the current research is to examine whether contextual cues affect flexible spatial and temporal social perspective taking in undergraduate students and teacher education students. Effects of the contextual cues on flexible spatial and temporal social perspective taking would demonstrate its contextual malleability. This malleability would suggest more or less flexible social perspective taking in perceived simple or challenging educational contexts. Thus, the malleability would underline the nature of a context-related phenomenon and state in higher education (instead of a trait). The findings from the current research would provide an important foundation for further research on social perspective taking as one mental resource that probably helps in classroom management and other contexts in social professions.

We focused on two educational contexts: (1) flexible spatial and temporal social perspective taking in undergraduate students with tasks describing situations in higher education courses, and (2) flexible spatial and temporal social perspective taking in teacher education students with tasks that describe classroom situations in the school. Both studies represent basic research for facilitating teaching, classroom management, and improving teaching quality (Hugener et al., 2009). Established tasks assessing flexible social perspective taking have been constructed under the relational frame theory (Barnes-Holmes et al., 2004, 2013; Hayes et al., 2001). We applied the relational frame theory and tested flexible spatial and temporal social perspective taking with regard to spatial and temporal relations in classes.

1.2 Relational frame theory and deictic frames in assessments of flexible social perspective taking

Given that different social perspectives are represented in text material which has been shown to improve social perspective taking (Cigala et al., 2015; Montoya-Rodríguez et al., 2017; Mori & Cigala, 2016), the current research attempted to capture the putative flexibility of spatial and temporal social perspective taking in different contexts with different samples. One approach to understanding the relationship between contexts and flexible spatial and temporal social perspective taking has emerged from behavioral psychology, especially from a functional-analytic account of language and cognition, known as relational frame theory (RFT, see Hayes et al., 2001).

For RFT, the acquired meanings and functions of words and social cues in a given language emerge as specific patterns of relational responding that include relating *I* to *you*. For RFT, pronouns such as *I*, *you*, and *they* specify the perspectives they represent. In more technical terms, *I* is in a relation of coordination with the self, but is in most contexts in a relation of distinction from *you*, *they* etc., thus maintaining separations between self and others, and facilitating shifts in perspective. For example, when a speaker says "*you"*, the listener always responds from the perspective of *I*, whereas when a speaker says "*I"*, the listener responds from the perspective of *you*. For RFT, this ability to shift from the perspectives of *I* and *you* is not only critical to perspective taking, but central to language itself (Gore et al., 2010; Hayes et al., 2001; Montoya-Rodríguez et al., 2017). These distinction relations, for example between *I* and *you*, are likely to be fundamental to flexible social perspective taking, because they allow one to distinguish between the perspective of self and the perspective of another, while being

able to adopt either or both in a given context (Ballard et al., 1997). The distinction between *I* and *you* is fundamental to social perspective taking and known as the Theory of Mind (Baron-Cohen et al., 1985; Wolgast, 2017; Wolgast et al., 2018; Wolgast & Barnes-Holmes, 2018) because it allows the person to distinguish between his or her own perspective and the perspective of another person and to switch between the two perspectives (McHugh et al., 2004a).

In the language of RFT, flexible social perspective taking is referred to as *deictic* relational responding and specifically involves: interpersonal relations (*I* and *you*), spatial relations (*here* and *there*), and temporal relations (*now* and *then*). It is important to emphasize that these relations interact with each other to create the complexity that comes to characterize having a perspective on oneself and others. That is, *I* is almost always coordinated with *here* and *now*, whilst *you*/*they* is almost always coordinated with *there* and *then* (Levin et al., 2012). In addition, the pronouns are coordinated when a related word of the pronoun (e.g., a person, place, or time) is used (McHugh et al., 2004b). For RFT, these patterns of relational responding get abstracted by the learner through a history of using language in these ways in certain contexts, thus enabling verbally-competent individuals to talk about events that have no actual basis in reality (e.g., talking about the future).

There is also evidence that perspective taking is stimulated by the three key linguistic features: Pronouns for interpersonal (*I* and *you*), spatial (*here* and *there*), and temporal relations (*now* and *then*, (McHugh et al., 2004a). In social interactions, these relations are linked together so that they produce directional meaning. In the context of social interactions, the directional meaning can stimulate people to take their own perspective or to think in terms of another person's perspective (Levin et al., 2012). Thus, pronouns stimulate different directions of thought and ideas from different perspectives. Pronouns, such as *you*, *there*, *then*, stimulate thinking away from ourselves to other individuals (i.e., external frame of reference). The pronoun *I* stimulates thinking about oneself and directs thus the attention inwards (i.e., internal frame of reference). Figure 1 shows the pronouns and their functional meaning for the internal and external frames of reference. Researchers empirically tested these assumptions of RFT in various studies (Cigala et al., 2015; Gore et al., 2010; Levin et al., 2012; McHugh et al., 2004b; Mori & Cigala, 2016). In addition, findings from other research directions fit the assumptions of internal and external frames of reference and their importance for perspective taking (e.g., from cognitive psychology, Brunyé et al., 2009; Pickering et al., 2012). For example, reading several sentences written in the second person (*you*) stimulated the external frame of reference in tasks assessing social perspective taking. In contrast, reading the same content written in the first person (*I*) stimulated the internal frame of reference in tasks assessing social perspective taking (e.g., Brunyé et al. 2009).

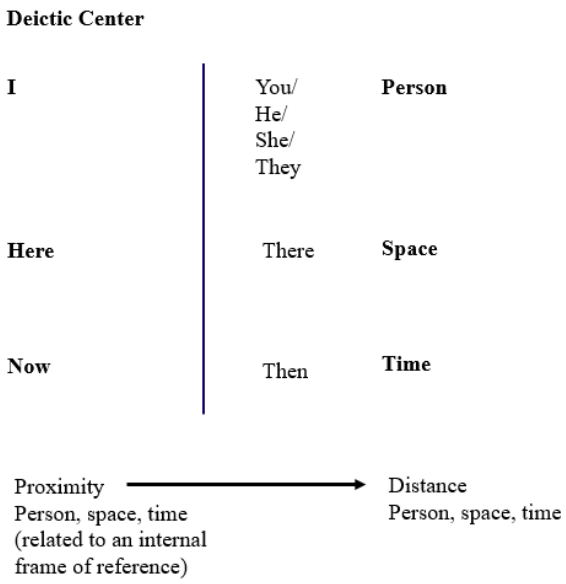

Fig. 1 Pronouns and their function

There is already evidence from many studies that supports RFT's account of flexible social perspective taking as deictic relational responding (Cigala et al., 2015; Gore et al., 2010; Levin et al., 2012; McHugh et al., 2004b; Mori & Cigala, 2016). For example, in a RFT-based protocol designed to assess flexible social perspective taking, researchers separated out the various types of relational patterns that comprise perspective taking, and distinguished among different levels of relational complexity (McHugh et al., 2004a). Consider a typical task that was presented without pictures, where the instruction to a child was: "If I am sitting here on a blue chair and you are sitting there on a black chair", followed by the two questions "Where are you sitting? Where am I sitting?" Answering the questions correctly was argued to involve responding in accordance with interpersonal relations (*I* and *you*) and spatial relations (*here* and *there*), and was *simple* at the level of relational complexity because neither the interpersonal relation nor the spatial relation was reversed. Now consider the following task that required responding in accordance with temporal relations: "Yesterday you were watching television, today you are reading. If now was then and then was now: what would you be doing then? What would you be doing now?" This task was denoted as a more complex reversed task because the temporal relation is reversed in the phrase "if *now* was *then* and *then* was *now*". In a study involving adults, researchers reported greater accuracy on simple vs reversed tasks, but no significant difference was observed between responding to spatial vs temporal relations (McHugh et al., 2004b).

2. The present research

Inspired by the outlined existing literature on clearly defined phenomena and the complex reality in school, we started at possible roots of considering all students in the classroom and asked whether tiny cues may affect flexible spatial and temporal social perspective taking in different samples in higher education. Higher education and school are characterized by different subjects that are often assigned to the mathematical vs verbal domains. These domains are related to many educational-relevant phenomena (e.g., self-concept, motivation, test anxiety, Möller et al., 2009; Siew et al., 2019; Wolgast, Hille, et al., 2020; Zeidner, 1991).

In Germany, prospective teachers at university may choose the subjects (e.g., French and Spanish; mathematics and sports) for their later work in a secondary school and have to study mainly these subjects. Thus, possible effects of their diverse subject combinations on flexible spatial and temporal social perspective taking with regard to different subjects might be hardly psychometrically controlled. In contrast, all psychology undergraduate students have to study statistics that is obviously part of the mathematical domain. That fact suggested the starting point to examine whether contextual cues to statistics (mathematical domain) vs English (verbal domain) affect undergraduate students' flexible spatial and temporal social perspective taking, before examining spatial and temporal flexible social perspective taking in teacher education students (i.e., prospective teachers). In this paper, we present therefore two different studies: (1) examining subject-related contextual cues on undergraduate students' flexible spatial and temporal social perspective taking and (2) examining space and time-related contextual cues on teacher education students' flexible spatial and temporal social perspective taking.

To our knowledge, there are no published findings on undergraduate students' and teacher education students' flexible spatial and temporal social perspective taking in exemplary classroom situations. Our specific research questions were as follows: (1) Is flexible spatial and temporal social perspective taking influenced by specific contextual cues, such as references to a fictitious course as "English" vs "statistics"? (2) Does the involvement of spatial vs temporal relations facilitate different performances on the flexible spatial and temporal social perspective-taking task? Thus, this research focused on flexibility in spatial and temporal social perspective taking within an RFT conceptual framework.

The aims of the two studies were as follows. (1) To investigate flexible spatial and temporal social perspective taking with regard to a fictitious college-based "English" vs "statistics" course with undergraduate students in Germany. (2) To explore the role of spatial and temporal relations in flexible

spatial and temporal social perspective-taking tasks involving statements about teaching a fictitious "maths" class presented to teacher education students in Germany.

Our hypothesis was (1) that the presence of "English" vs "statistics" as a contextual cue would result in faster and more accurate flexible spatial and temporal social perspective taking on the contextual cue "English" relative to "statistics", because "English" would be deemed easier. (2) For Study 2, we had no hypothesis. We explored differential performances in flexible spatial and temporal social perspective taking with the involvement of spatial vs temporal relations because we were somewhat uncertain as to the nature of this potential difference.

To test our hypothesis, we conducted power analyses using the R package *pwr* (Champely, 2017) and effect sizes taken from previous research. For example, researchers compared response times on tasks involving relational responses to "self", "other", and to a photograph as target stimuli (we used a similar format here, see supplemental file A), resulting in an effect of a Cohen's $d = .79$ in favor of "self" responses (McHugh et al., 2007). In Study 1, therefore, the flexible spatial and temporal social perspective-taking task with different contextual cues ("English" vs "statistics") presented 48 tasks and required at least $n = 16$ participants to disclose effects (Cohen's $d = 0.79$, significance level = .05, power = .80, type = "one.sample") within participants (Champely, 2017). Study 2 had an exploratory nature with a within-subject design between the flexible spatial and temporal social perspective-taking tasks, such that an a priori power analysis was not indicated. We conducted instead a post hoc power analysis (see 4.2 Results). All of the current experimental work had received ethical approval from the relevant committee and was conducted accordingly.

2.1 General procedure

Each participant engaged with an individual laptop for e-exams. All aspects of the procedure were automated and presented via PsychoPy (Peirce et al., 2019). All participants received instructions for logging in and commencing the study at the same time in Studies 1 and 2. They were verbally instructed: "Follow the instructions on the screen!" These were as follows: "Welcome! In the following, you will read statements and questions. Below each question, you will see two words. Choose one of these words to answer the question. Press "*n*" to move forward!" Prior to the first task, the following instruction appeared: "It will start right away. Answer as accurately and quickly as you can! Press "*n*" to start!" On each task, participants emitted a response by pressing the *n* key (on the left of the keyboard), or *m* (on the right) to select the response option displayed on that side of the screen.

On all tasks, the first statement was centrally displayed in white characters on a dark grey background, with the question below presented in identical format. Approx. 2cms below the question were the two response options, also in white characters approx. 10cm apart. On all tasks, "I" as it appeared on-screen referred to the computer's perspective and "you" referred to the participant's perspective. On all simple tasks, the correct answer matched the task statement, whereas on all reversed tasks, the correct response involved reversing the target relation (essentially responding incorrectly).

The test tasks were presented in random order. A white fixation cross was displayed between each task. Participants could not skip any task, nor could they return to a previous task. Each task remained on-screen until a response was emitted. No time limit was applied on any flexible spatial and temporal social perspective-taking task. No feedback or consequences for responding were provided on any task. Completion of the last task marked the end of the participation.

2.2 Materials

In the current two studies, we adapted flexible spatial and temporal social perspective-taking tasks from previous research (McHugh et al., 2004b) to contexts familiar to higher education. We adapted the established tasks (McHugh et al., 2004b) to the current studies, based on videos of actual maths classes (Rakoczy et al., 2005), situations in maths classes described in the literature (Rose, 2018), the German teacher education standards (HRK, 2015; KMK & HRK, 2015), and the Qualifications Framework for German Higher Education Degrees (Bartosch & Grygar, 2019; HRK et al., 2011; KMK

& HRK, 2015). The tasks describe different situations where individuals reflect on their competence levels by perceived academical challenges or not and applying the individual reference norm (Rheinberg, 1977) to themselves or to others. Most of the tasks provide the temporal relations YESTERDAY-TODAY and spatial relations HERE-THERE necessary for applying the reference norm except one task which describes I-YOU relations and spatial relations. For testing effects of contextual cues within the tasks in Study 1, we adapted the tasks to the mathematical vs verbal academic domain in higher education with replacing "maths class" by "statistics course" vs "English course" respectively. In this way, we examined flexibility in spatial and temporal social perspective taking in the presence of different cues that specified various contexts.

All aspects of the research and its materials were presented in German, but are translated into English for current purposes. The protocol presented in Study 1 comprised 48 test tasks, all adapted from previous research (McHugh et al., 2004b). There were 24 tasks that referred to English and 24 almost identical tasks that referred to statistics. [1]Each set of tasks contained a mix of spatial and temporal relations in simple and reversed form. The reader is strongly advised to consult supplemental file A which contains all 24 statistics tasks, where each question represents one task. The 24 English tasks were identical, but referred to English rather than statistics. Each statement shown in supplemental file A was presented twice, with each exposure containing one of the two relevant questions (see supplemental file C for all tasks in German).

All aspects of the apparatus from the previous study were identical in Study 2. The format of all tasks presented in Study 2 was identical to the previous study. In Study 2, the questions pertaining to each task contrasted the perspective of I (the computer) with you (participant) or with students (others). Study 2 presented a total of 15 tasks, which contained spatial tasks and temporal tasks, all in reversed form. The reader is strongly advised to consult in supplemental file B which contains all 15 tasks, separated by task-type. Each task was presented once, accompanied by a single relevant question.

2.3 Statistical analyses

Revelle (2019) provides a tool for analyzing internal consistency of multidimensional constructs by McDonald's ω for binary data (R package *psych*, see also https://www.personality-project.org/r/html/omega.html for details). We used McDonald's ω to measure internal consistency and structure of the tasks used in the Studies 1 and 2 (Dunn et al., 2014; Revelle, 2019).

As the responses on the tasks were binomial (correct/incorrect response), we ran a Rasch-tree model (Strobl et al., 2016) to detect different item functioning of responses and irregular response behavior reflecting low test-taking motivation. The Rasch tree has been used in previous research for detecting potentially different item functioning of responses (Strobl et al., 2015). Responses and response times were included in previous Rasch tree analyses for detecting low test-taking motivation in participants (Ranger & Kuhn, 2017). We applied the Rasch-tree model within the R environment (R Development Core Team, 2009) by the R package *psychotree* (Strobl et al., 2016). The R codes can be obtained from the corresponding author. To test mean differences in responses (i.e., mean accuracy) and response times (depending on the cue "English" vs "statistics" in Study 1, and depending on the presence of spatial vs temporal relations in Study 2), we used general linear models (GLMs) for repeated measures.

3. Study 1

The aim of Study 1 was to examine any potential differences between responding to flexible

[1]We included 24 tasks each for English and statistics after using Revelle's (2018) tool for a two-factor solution that resulted in an ω = .70, suggesting acceptable internal consistency of both factors.

spatial and temporal social perspective-taking tasks that referred to English vs statistics. There is increasing evidence of statistics anxiety among students in social sciences in higher education (Bourne, 2018; Onwuegbuzie, 2004; Siew et al., 2019; Zeidner, 1991). Thus, we predicted superiority (i.e., higher accuracy, lower latency) in responding to the set of tasks involving the cue English over the set of tasks involving the cue statistics. In other words, our simple question was whether a single cue in one area over another would influence the accuracy or response time of flexible spatial and temporal social perspective taking in that domain?

3.1 Participants and setting

Forty-four undergraduate students (one male and 43 females, M_{age} = 22 years) attended for a university lecture in Germany. Recruitment was part of a university module in psychology, but was undertaken voluntarily. Study 1 was entirely conducted in an e-exam hall at the relevant university. Two researchers were present at all times. Each participant was randomly assigned to an individual desk (approx. 2m apart), at which they waited until all participants were seated. Participants completed the tasks in a mean of 8.37 minutes (*SD* = 0.30) and waited in their seats until all participants had finished.

3.2 Results

Initially, we excluded all response time outliers with a *SD* > 1.5 above/below each task mean (Semmelmann & Weigelt, 2017). This left *n* = 41 participants. Table 1 provides *M* and *SD* of response times and accuracy on the flexible spatial and temporal social perspective taking tasks. Mean accuracy on English tasks vs statistics was not significant $F(1, 40) = 1.15$, $p = .29$ (see Table 1 for *M* and *SD*). However, the mean latency on statistics was significantly longer than English, $F(1, 40) = 160.56$, $p < .001$, $\eta_p^2 = .80$, Cohen's $d = 1.96$ (Cohen, 1988), with a large effect (Lenhard & Lenhard, 2016). Mean accuracy on 'spatial and spatial-temporal tasks' was .51 vs 'temporal tasks' at .50, thus the difference was not significant $F(1, 40) = 0.42$, $p = .52$. However, the mean latency on 'spatial and spatial-temporal tasks' was 2.07 (see Table 1 for *SD*), and on 'temporal tasks' was 1.90, which was significant $F(1, 40) = 68.32$, $p < .001$, $\eta_p^2 = .63$, $d = 1.26$. The added product term 'course' × 'relations' suggested no interaction effect between the tasks including the cue English vs statistics course and the tasks including the cues 'spatial and spatial-temporal tasks' vs 'temporal tasks' $t(40) = .66$, $p = .51$. There was, however, an interaction effect between the latency on the tasks including the cue English vs statistics course and the latency on the tasks including the cues 'spatial and spatial-temporal tasks' vs 'temporal tasks' $t(40) = 4.63$, $p < .001$, $d = 0.82$.

Table 1

Study 1: Undergraduate students' mean response accuracy and response time on flexible social perspective-taking tasks including the contextual cues to an English course, statistics course, 'spatial, spatial-temporal' and 'temporal' relations

Study 2: Teacher education students' mean response accuracy and response time on flexible social perspective-taking tasks including the contextual cues to teaching a maths class, reversed spatial and reversed temporal relations

	Course	Relations	Accuracy		Response time	
			M	*SD*	*M*	*SD*
Study 1	English		.52	.12	[**1.81**	.28
	Statistics		.48	.10	**2.15**]	.26
		Spatial, spatial-temporal	.51	.10	[**2.07**	.27
		Temporal	.49	.11	**1.90**]	.26
	English	Spatial, spatial-temporal	.53	.17	[**1.87**	.34
		Temporal	.52	.16	**1.74**]	.27
	Statistics	Spatial, spatial-temporal	.50	.14	[**2.26**	.26
		Temporal	.47	.14	**2.05**]	.29
Study 2	Maths					
		Reversed spatial	[**.94**	.16	2.24	.37
		Reversed temporal	**.90**]	.18	2.21	.30

Note. Means in brackets significantly differ from each other (i.e., $p < .05$).

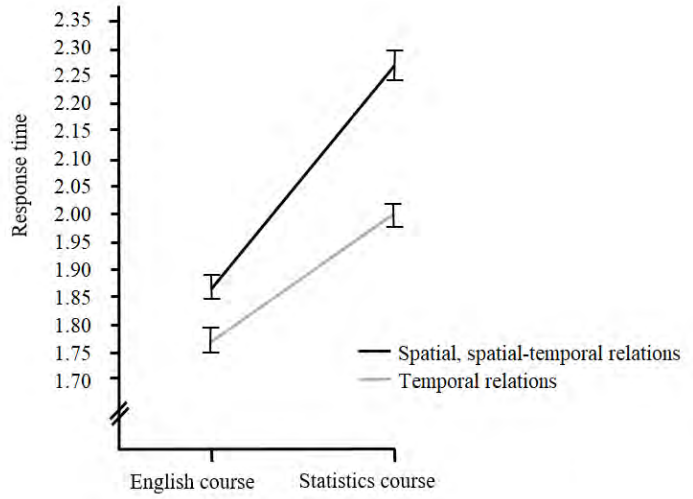

Fig. 2 Study 1: Mean response time on flexible spatial and temporal social perspective taking tasks including cues to courses (English vs statistics) and spatial-temporal/temporal relations with 95% confidence intervals

We additionally employed a Rasch-tree analysis (Strobl et al., 2015, 2016) to assess for differential item functioning and low test-taking motivation (Ranger & Kuhn, 2017), but this was not supported (see Figure 3). The Rasch-tree analysis including all 48 responses yielded a single node that indicated equivalent item functioning of responses on spatial and temporal relations (Strobl et al., 2016). The Rasch-tree analysis including the 48 response times as covariates (see Ranger & Kuhn, 2017, for details) on the corresponding 48 responses yielded again the single node (see Figure 3) that indicated no differential test-taking motivation patterns.

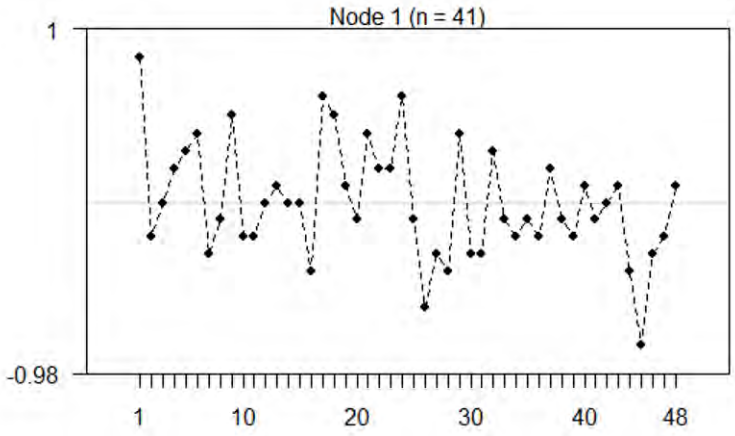

Fig. 3 Study 1: The single node from Rasch tree analysis (indicating no differential item functioning and no differential test-taking motivation patterns) with 48 end nodes representing estimates of task difficulty (y-axis) for each task (x-axis)

4. Study 2

Given that performances on spatial vs temporal relations did not appear to vary when these tasks were presented in simple form in Study 1, we queried in Study 2 whether differences might be recorded when spatial and temporal relation types were presented in reversed form. Previous evidence indicates that reversing both types of relation does increase the difficulty of the flexible social perspective taking task, but there is little or no research on whether the observed superiority of spatial over temporal relations remains when each is reversed (McHugh et al., 2004a, 2004b). However, it is important to note in advance that the construction of the tasks and our statistical analyses did not permit this type of strict comparison of relation type, but did allow us some level of interesting comparison in terms of relation type (i.e., flexible spatial vs temporal social perspective taking tasks).

4.1 Participants and setting

One hundred and seventy-six teacher education students (49 males and 127 females, M_{age} = 24 years) participated in Study 2 online via Qualtrics for course credit in Germany. All participation was undertaken voluntarily. Participants completed the tasks in approx. 23 minutes (M = 22.65, SD = 3.25)

4.2 Results

Again, we excluded all response time outliers with a $SD > 1.5$ above/below each task mean (Semmelmann & Weigelt, 2017). This left n = 149 participants. Note that all tasks were reversed tasks

(see supplemental file B). Table 1 presents *M* and *SD* for the reversed spatial tasks and reversed temporal tasks, thus the spatial task mean was significantly higher than the temporal task mean, $F(1, 148) = 7.93$, $p = .01$, $\eta_p^2 = .05$, $d = 0.46$, with a moderate effect. The mean latency on reversed spatial tasks was 2.24 ($SD = 0.37$) and on reversed temporal tasks was 2.21 ($SD = 0.30$), which was non-significant $F(1, 148) = 3.28$, $p = .07$. Again, we employed a Rasch-tree analysis by including all flexible reversed spatial and temporal social perspective taking tasks in a Rasch-tree model to assess for differential item functioning and differential test-taking motivation. The analysis yielded one single node that suggested measurement invariant item functioning between the two types of relations (i.e., flexible spatial vs temporal social perspective taking tasks), also including response times as covariates indicating no differential response time patterns (see Figure 4). Finally, we conducted a post hoc power analysis to obtain information on the power of Study 2 which yielded 86% power ($n = 176$ participants, Cohen's $d = 0.46$, significance level = .05, type = "one.sample", Champely, 2017).

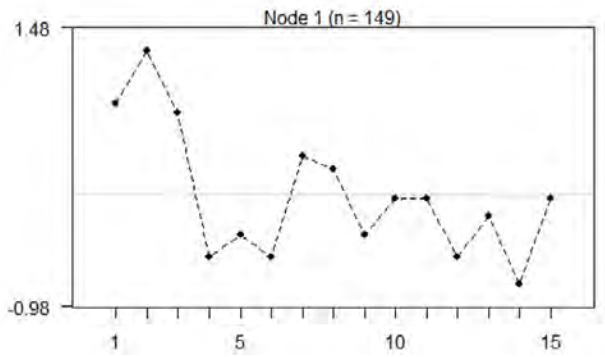

Fig. 4 Study 2: The single node from Rasch tree analysis (indicating no differential item functioning) with 15 end nodes representing estimates of task difficulty (y-axis) for each task (x-axis).

5. General discussion

Psychologists and teachers need flexible spatial and temporal social perspective taking for fast shifting on spatial and temporal relational perspectives for understanding diverse individual's and heterogeneous group's behavior. Spatial relational perspectives may direct teacher's attention to student's positions in the classroom. Temporal relational perspectives often direct teacher's attention to actions or reactions at a certain time point.

The aim of the current research was to examine whether contextual cues affect flexible spatial and temporal social perspective taking in prospective psychologists (i.e., undergraduate students) and teachers (i.e., teacher education students). We assessed flexible spatial and temporal social perspective taking by established tasks (McHugh et al., 2004b). These tasks include contextual cues to classroom situations and can be presented in higher education classes.

We focused on two educational contexts: (1) flexible spatial and temporal social perspective taking in undergraduate students with tasks describing situations in higher education courses, and (2) flexible spatial and temporal social perspective taking in teacher education students with tasks that describe classroom situations in school. This research was basic research for facilitating teaching, classroom management, and improving teaching quality (Hugener et al., 2009).

5.1 Flexible social perspective taking within the RFT

In the current two studies, we applied RFT (Barnes-Holmes et al., 2004) to classes in higher education and tested the hypothesis (1) that the presence of "English" vs "statistics" as a contextual cue results in faster and more accurate flexible spatial and temporal social perspective taking on the former cue than the latter cue. Then, we followed the exploratory question (2) whether the involvement of spatial vs temporal perspective relations can facilitate different performances on the flexible spatial and temporal social perspective taking tasks?

Prerequisites for analyzing the collected data are motivation reflected in regular response times and item functioning, that we examined by Rasch-tree analyses. We applied Rasch-tree analyses to detect different item functioning and low test-taking motivation, and GLMs in both studies to test the hypothesis (1) in Study 1 and answer the explorative question (2) in Study 2.

In Study 1, the single Rasch tree node suggested measurement invariant item functioning between tasks involving cues for an "English" course vs a "statistics" course. In case of different item functioning, the Rasch tree would yield more than one node (Strobl et al., 2016). In Study 2, the single node suggested measurement invariant item functioning between tasks involving reversed spatial vs temporal relations. Taking response times into account in the Rasch tree allowed us to analyze if irregular response processes occurred (e.g., due to low test-taking motivation, see Ranger & Kuhn, 2017). However, we did not find irregular response processes by the Rasch tree analysis in Study 1 or Study 2. Apparently, there is an odd difference in the total response times on the 48 tasks in approx. eight minutes in Study 1 vs 15 tasks in approx. 23 minutes in Study 2. We can only speculate why the total response times differed in this way. Indeed, the tasks presented differed because Study 2 involved only reversed perspective relations.

Undergraduate students' accuracy (solving probability 48–51%) was at a moderate level in Study 1. That is, the tasks seemed to be more difficult for the undergraduate students in Study 1 than the teacher education students in Study 2 (solving probability 90–94%). The teacher education students responded very accurately, representing high flexible spatial and temporal social perspective taking, even though the tasks with reversed spatial vs temporal relations in Study 2 should be more difficult than the mainly simple spatial and temporal relations in Study 1. On the other hand, the teacher education students' total response times (approx. 23 minutes) were fairly long.

A person can respond slowly on tasks in order to make as few mistakes as possible or they can respond quickly despite the risk of mistakes. This is called the speed-accuracy trade-off (Wickelgren, 1977; Zimmerman, 2011). In an ideal world, a person strives for maximum performance on both components. The undergraduate students in Study 1 seemed to respond as quickly as possible despite the risk of more mistakes. Their response and response time means (see Table 1) might suggest rapid guessing, however, the response times differed depending on the contextual cues. The undergraduate students might have focused on the cues without reflecting fully on the situation described in each task, and were thus able to respond quickly (e.g., focusing on I-YOU and HERE-THERE relations). Thus, they possibly decided just on these cues as criteria without considering the described context. In Study 2, the teacher education students seemed to respond slowly in order to increase their overall accuracy level. They may have connected more with the situation presented in the tasks than the undergraduate students in Study 1. Thus, they possibly decided on the context as criterion.

We examined the effects of using the single words "English" or "statistics" as cues on flexible spatial and temporal social perspective taking tasks, and our results supported our hypothesis in part because the undergraduate students responded more quickly on "English" tasks over "statistics", although they responded with similar accuracy on the flexible spatial and temporal social perspective taking tasks, including the cue "English" vs "statistics". The significantly faster responses on tasks involving the cue "English" can be explained with findings from other studies suggesting that reading activates mental representations (O'Brien & Albrecht, 1992).

Moreover, the longer response times on the tasks including the cue "statistics" than "English" might result from statistics anxiety even in undergraduate students who already had to pass several statistics courses, according to the previous findings from that field (Bourne, 2018; Onwuegbuzie,

2004; Onwuegbuzie & Seaman, 1995; Siew et al., 2019; Zeidner, 1991). Note, we did not assess statistics anxiety with an established inventory and can only speculate that the undergraduate students already perceived the cue "statistics" as a threat. If so, this threat may affect their response times with longer response latencies related to the cue "statistics" relative to the cue "English" in terms of the thread-related attentional bias (Bar-Haim et al., 2007).

We also examined whether the presentation of spatial vs temporal relations within the task would influence the flexible social perspective-taking performances. The analyses yielded longer latencies on 'spatial and spatial-temporal' relations over 'temporal' relations. This result might reflect the focus on the cues rather than the context because HERE-THERE relations required encoding of several words describing the context while just looking for the cues for answering the question "Where…?". In contrast, YESTERDAY-TODAY (i.e., NOW-THEN relations in RFT) provided the necessary information to answer the question "When…?" (see supplemental file A).

The interaction effect of the cues to the English vs statistics course × the 'spatial and spatial-temporal' vs 'temporal' relations in the tasks on the corresponding response times showed that the relations moderated the influence of the cues to the English vs statistics course on the corresponding response times. It is an ordinal interaction (Loftus, 1978). The main effects are interpretable (as discussed above) and the ordering of the data points corresponding to the levels 'English' vs 'statistics' of the independent variable 'course' depends on the level 'spatial and spatial-temporal' vs 'temporal' of the independent variable 'relations'. This finding suggests that the 'spatial and spatial-temporal' relations additionally extended the response time on tasks involving the cue "statistics".

The results of Study 2 suggested effects of spatial over temporal relations on flexible spatial and temporal social perspective taking performances. The teacher education students responded significantly more accurately on the tasks involving spatial rather than temporal relations. This result suggests the assumption that the teacher education students used another response strategy (e.g., imagining the classroom situation from the perspective of students) to solve the tasks, relative to the undergraduate students. The teacher education students seemed to decide on the context as criterion rather than specific cues and put themselves in the complex context of the described classroom situation.

The effects of the contextual cues on flexible spatial and temporal social perspective taking demonstrated its contextual malleability. This malleability suggests more or less flexible spatial and temporal social perspective taking in perceived simple or challenging educational contexts. Thus, the malleability underlines the nature of a context-related phenomenon and state in higher education (instead of a trait). The presented findings provide an important foundation for further research on social perspective taking as one mental resource that likely helps in higher education and school (e.g., in classroom management, social support, or peer learning).

5.2 Flexible social perspective taking in educational contexts

From an educational research perspective, the results indicate that flexible spatial and temporal social perspective taking performances differ between higher education students. The results also indicate different flexible spatial and temporal social perspective taking performances within higher education students from one to another educational situation described in the tasks. Observing these differences suggests that the teacher education students (i.e., prospective teachers) each constructed and updated an individual meaning to the situations briefly described in the tasks. Some tasks (presented to the prospective teachers) describe teachers who reflect on their competence levels by perceived academic demands or positive experiences with students in the educational space of a maths class (incl. the spatial relation HERE-THERE). The spatial relations require to shift between HERE and THERE similar to real teaching situations where the teacher has to shift between the subjective point of view HERE and the students THERE in an educational space (e.g., classroom). Other tasks describe teachers who apply the individual reference norm (Rheinberg, 1977) to themselves or to students. These tasks include the temporal relation YESTERDAY-TODAY which is necessary for applying the individual reference norm.

Constructing an individual meaning and flexible spatial and temporal social perspective taking seemed difficult for several prospective teachers. The prospective teachers might also have difficulties in seeing what real students see (e.g., after transitions between lesson sequences) and if they see the learning materials as the teacher intended. If students do not see the learning material as the teacher intends (Wolgast, 2017; Wolgast, Tandler, et al., 2020; Wolgast & Oyserman, 2019), they may feel anger and disrupt the lesson. Disruptive student behavior is often a challenge for teacher classroom management (Lipowsky et al., 2009). In addition, prospective teachers who have difficulties in applying flexible spatial and temporal social perspective taking may have difficulties in applying the individual reference norm to students in a real classroom. The teacher's use of the individual reference norm is important because it was positively related to student academic motivation (Klopsch et al., 2022; Rheinberg, 2001) and negatively related to cheating in school (Marksteiner et al., 2021).

Teaching situations are complex. Frequently used flexible spatial and temporal social perspective taking may facilitate the consideration of all students with diverse learning backgrounds (Scanlon & Barnes-Holmes, 2013; Wolgast, Tandler, et al., 2020). According to the results presented, contextual events may influence flexible spatial and temporal social perspective taking. Whether flexible spatial and temporal social perspective taking can be stimulated in teacher trainings, even under possible influences of contextual events, remains an open question for future research.

5.3 Limitations

The participants here represent self-selected samples tested in groups (one person at one laptop) or online, thus restricting the generalizability of the findings. Without a probabilistic sample, additional variables (e.g., socio-economic background, general intelligence, current distress or anxiety) may well have contributed to any observed variability in the flexible perspective taking performances. As noted above, the gender distribution was not equal in the studies; only one male participated in Study 1. Indeed, our flexible spatial and temporal social perspective taking tasks were language-based (i.e., statements), in contrast to other tasks used in perspective taking research (Erle & Topolinski, 2015; Janczyk, 2013; Wolgast, Tandler, et al., 2020; Wolgast & Oyserman, 2019). Nevertheless, the studies contribute to the understanding of the potential relationship between contextual cues and tested social perspective-taking processes (not only self-reports) with regard to educational contexts.

5.4 The implications of the study and findings for educational research and practice

The current study provides insights into presumed underlying processes of learning in higher education and student orientation of prospective teachers. Based on the findings of this study, students' flexible spatial and temporal social perspective taking varies between them, and within them from one educational context to another. Future research might investigate the potential benefits to learners and teachers of establishing flexible social perspective taking.

The flexibility of social perspective taking was assessed by tasks, rather than by subjective measures such as self-reports. Future research may consider the possible training effects that could be obtained with this type of task in terms of facilitating social perspective taking in real educational situations. Teachers may facilitate students' learning by an orderly classroom atmosphere with few disruptions and discipline problems (Lipowsky et al., 2009). Ideally, a teacher's attention flexibly alternates between the teacher's own planned teaching actions and each student, depending on the situation and social priority. The teacher should alternate their attention while applying professional knowledge in order to respond to learners. Flexible spatial and temporal social perspective taking may help them to shift between personal classroom experience and students' situations (Scanlon & Barnes-Holmes, 2013).

Moreover, flexible spatial and temporal social perspective taking can be used to measure intervention effects of other trainings in educational contexts (e.g., educational simulations, Cigala et al., 2015; Holmes, 2019; Scanlon & Barnes-Holmes, 2013). Various further training approaches including the flexible spatial and temporal social perspective taking tasks are possible with relatively little effort. One training approach relates to teachers' attitudes toward learners with special needs (Scanlon & Barnes-Holmes, 2013). Before and after an acceptance and commitment training, teachers' attitudes, self-efficacy expectations, and stress experience were assessed with a questionnaire. At both time points, testing occurred to determine the extent to which teachers engaged in flexible spatial and temporal social perspective taking among learners with different characteristics (Scanlon & Barnes-Holmes, 2013). Compared to the first measurement, teachers showed statistically significantly more positive attitudes, higher self-efficacy expectations, and flexible spatial and temporal social perspective taking toward learners with special needs after the training. In addition, teachers reported statistically significantly higher stress levels before the training than after (Scanlon & Barnes-Holmes, 2013). Accordingly, flexible spatial and temporal social perspective taking presumably facilitates consideration of all students with diverse learning backgrounds. This assumption might be tested in further research.

However, the different constructed meanings when reading about situations in a maths class imply differences in the prospective teachers' flexible spatial and temporal social perspective taking in educational situations. Difficulties with one or both forms may hinder learning in higher education, giving appropriate social support in psychological or educational contexts, and in managing groups or classes (Scanlon & Barnes-Holmes, 2013; Wolgast, Tandler, et al., 2020; Wolgast & Oyserman, 2019). We recommend to support especially prospective teachers with difficulties in applying flexible spatial and temporal social perspective taking to improve both forms for considering each student's angle of view in heterogeneous classes and for the equal inclusion of all students.

Flexible spatial and temporal social perspective taking could be practiced in trainings for (prospective) teachers in educational contexts. Discussing their experiences of such trainings might help to stimulate flexible spatial and temporal social perspective taking and the related social orientation to others instead of only focusing oneself. Several intervention studies can be used to develop workshops that are particularly suitable for teachers and their consideration of the students' physical positions in the class (Scanlon & Barnes-Holmes, 2013; Wolgast, Tandler, et al., 2020; Wolgast & Oyserman, 2019). Teachers need such skills and strategies that subjectively facilitate teaching and prevent exhaustion and burnout. In addition, positive teacher-student interactions with all learners can be expected if all learners feel equally considered and supported by a teacher, for example. This consideration could strengthen positive student-teacher interactions and stabilize a social atmosphere conducive to learning. Moreover, flexible spatial and temporal social perspective taking might provide space and time for learners' co-constructions and relational perspectives in virtual environments (Damşa et al., 2019).

5.5 Conclusion

Flexible spatial and temporal social perspective taking appears to be essential to psychologist's and teacher's understanding and acceptance of diverse learners. We see the concepts of flexible spatial and temporal social perspective taking as a prerequisite for addressing the learning needs of all learners in the classroom. The impact of the current work involves new findings about the state flexible spatial and temporal social perspective taking and its malleability in higher education. The malleability suggests that flexible spatial and temporal social perspective taking can be stimulated in an intervention. In teacher training, the mental moving away from the own person and approaching perspectives of learners should be trained supra-disciplinarily and subject-didactically. The same applies to further training courses aimed at teachers, school psychologists and further educators.

We presented insights in prospective psychologists' and teachers' flexible spatial and temporal social perspective taking in higher education. The tasks presented here and further developed tasks of

this type can be implemented in interventions to increase accuracy and reduce latency in social coordination processes in educational contexts. Training programs should aim at the fact that psychologists and teachers routinely consider, understand and support students with different and unfamiliar learning preconditions in the classroom. For example, texts with descriptions of the same classroom situation from the perspective of teachers and from the perspective of different students are suitable for this purpose. If teachers also regularly participate in training, they put themselves in the role of learners and experience teaching-learning situations from a different perspective.

Keypoints

- In two studies, we employed the relational frame theory, a within-subject design with 220 participants, and analyzed the data by Rasch-tree and general linear modeling.
- The results showed faster responding on flexible social perspective-taking tasks, involving a fictional college course in “English” rather than “statistics” (Study 1).
- Participants responded more accurate on flexible social perspective-taking tasks involving spatial rather than temporal relations with regard to a maths class (Study 2).
- The results shed some light on the integration of different approaches for research on flexible social perspective taking and learning in educational contexts.

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Appendix

Task Study 1

All flexible spatial and temporal social perspective-taking tasks presented in Study 1 according to task-type

<table>
<tr><td colspan="4">Spatial I-YOU tasks</td></tr>
<tr><td colspan="2">Simple I-YOU</td><td colspan="2">Reversed I-YOU</td></tr>
<tr><td colspan="2">I am standing here writing statistics hints on the board and you are sitting there doing statistics tasks</td><td colspan="2">I am standing here writing statistics hints on the board and you are sitting there doing statistics tasks,
if I was you and you were me</td></tr>
<tr><td>Where are you doing statistics tasks?
(There)</td><td>Where am I writing statistics hints?
(Here)</td><td>Where would I be?
(There)</td><td>Where would you be?
(Here)</td></tr>
<tr><td colspan="4">Spatial-Temporal I Tasks</td></tr>
<tr><td colspan="2">Simple HERE-THERE</td><td colspan="2">Reversed HERE-THERE</td></tr>
<tr><td colspan="2" rowspan="2">Today I am writing statistics hints here, yesterday I was agreeing with ideas about statistics problems there</td><td colspan="2">Today I am writing statistics hints here, yesterday I was agreeing with ideas about statistics problems there,
if here was there and there was here</td></tr>
<tr><td>Where was I writing?
(There)</td><td>Where was I agreeing?
(Here)</td></tr>
<tr><td rowspan="2">Where was I writing?
(Here)</td><td rowspan="2">Where was I agreeing?
(There)</td><td colspan="2">Today I am standing here in statistics class writing statistics hints,
yesterday I was standing there in statistics class and that was fun,
if here was there and there was here</td></tr>
<tr><td>Where am I standing now?
(There)</td><td>Where was I having fun?
(Here)</td></tr>
<tr><td colspan="4">Spatial-Temporal YOU tasks</td></tr>
<tr><td colspan="4">Today you are struggling to solve statistics tasks here, yesterday you were doing statistics tasks there</td></tr>
<tr><td colspan="2">Where were you struggling to solve statistics tasks?
(Here)</td><td colspan="2">Where were you doing statistics tasks?
(There)</td></tr>
<tr><td colspan="4">Temporal I tasks</td></tr>
<tr><td colspan="2">Simple NOW-THEN</td><td colspan="2">Reversed NOW-THEN</td></tr>
<tr><td colspan="2">Yesterday my work in statistics class was challenging, today I am doing work in statistics that is fun</td><td colspan="2">Yesterday my work in statistics class was challenging, today I am doing work in statistics that is fun,
if yesterday was today and today was yesterday</td></tr>
<tr><td>When was my work</td><td>When was my work</td><td>When was my work</td><td>When was my work fun?</td></tr>
</table>

challenging? (Yesterday)	fun? (Today)	challenging? (Today)	(Yesterday)
Yesterday I wrote statistics hints, today my work in statistics is easy		Yesterday I wrote statistics hints, today my work in statistics is easy, if yesterday was today and today was yesterday	
When was I writing statistics hints? (Yesterday)	When was my work in statistics easy? (Today)	When was I writing statistics hints? (Today)	When was my work in statistics easy? (Yesterday)
Temporal YOU tasks			
Simple NOW-THEN		**Reversed NOW-THEN**	
Yesterday you were doing statistics tasks, today you are struggling to solve statistics tasks		Yesterday you were doing statistics tasks, today you are struggling to solve statistics tasks, if yesterday was today and today was yesterday	
When were you doing statistics tasks? (Yesterday)	When were you struggling to solve statistics tasks? (Today)	When were you doing statistics? (Today)	When were you struggling to solve statistics tasks? (Yesterday)

Task Study 2

All flexible reversed spatial and temporal social perspective-taking tasks presented in Study 2 according to task-type

Spatial: Reversed HERE-THERE tasks	
I tasks	
I am sitting here at the window signing in the class book and the students are sitting there writing maths hints, if here was there and there was here	I am here with students and the other students are writing there with concentration, if here was there and there was here
Where was I sitting? (There)	Where was I? (There)
I am going here through the aisle and the students are going there to the models, if here was there and there was here	
Where was I going? (There)	
Other tasks	
I am standing here writing maths tips on the board and the students are sitting there doing maths tasks, if here was there and there was here	
Where were the students doing maths tasks? (Here)	
I am here drawing a triangle on the board and the student is there and calculates an angle, if here was there and there was here	
Where was the student? (Here)	
I am standing here pointing to the Pythagorean theorem in a book, a student is standing there and is bored,	

if here was there and there was here
Where was the student? (Here)
I am sitting here and holding the book that includes the Pythagorean theorem, The student is sitting there holding the book 10cm apart from her eyes, if here was there and there was here
Where was the student sitting? (Here)
I am sitting here beside the projector and pointing to a triangle, a student there at the table is painting a triangle in green, if here was there and there was here
Where was the student? (Here)
Temporal: Reversed NOW-THEN tasks
I tasks
Yesterday the students were struggling to solve maths tasks and today I am demonstrating the solution, if yesterday was today and today was yesterday
When was I demonstrating the solution? (Yesterday)
Yesterday the students solved maths problems in groups and today I am listening carefully to students, if yesterday was today and today was yesterday
When was I listening to students? (Yesterday)
YOU tasks
Yesterday you had fun doing maths tasks, today you are looking out the window, if yesterday was today and today was yesterday
When had you fun? (Today)
Yesterday you were drawing, today you are often raising your hand, if yesterday was today and today was yesterday
When were you drawing? (Today)
Yesterday you were drawing a triangle, today you are struggling to solve the task, if yesterday was today and today was yesterday
When were you drawing the triangle? (Today)
Yesterday you were doing maths tasks, today you are struggling to solve maths tasks, if yesterday was today and today was yesterday
When were you doing maths tasks? (Today)
Other tasks
Yesterday the students were doing maths tasks,

today the students are struggling to solve maths tasks, if yesterday was today and today was yesterday
When were the students struggling to solve maths tasks? (Yesterday)

Supplemental file C

All flexible social perspective-taking tasks used in Studies 1–3

Study 1: Flexible social perspective-taking tasks used in German in randomized order

1 Ich bin auf einem hohen Kompetenzniveau in Statistik, du auf einem niedrigen. Auf welchem Kompetenzniveau bist du in Statistik?

niedrig *hoch*

2 Ich bin auf einem hohen Kompetenzniveau in Statistik, du auf einem niedrigen. Auf welchem Kompetenzniveau bin ich in Statistik?

niedrig *hoch*

3 Ich bin auf einem hohen Kompetenzniveau in Statistik, du auf einem niedrigen. Wenn ich du wäre und du wärst ich, auf welchem Kompetenzniveau wärst du in Statistik?

niedrig *hoch*

4 Ich bin auf einem hohen Kompetenzniveau in Statistik, du auf einem niedrigen. Wenn ich du wäre und du wärst ich, auf welchem Kompetenzniveau wäre ich in Statistik?

niedrig *hoch*

5 Ich stehe hier und schreibe Statistik-Tipps an die Tafel und du sitzt dort und bearbeitest Statistikaufgaben. Wo bearbeitest du Statistikaufgaben?

hier *dort*

6 Ich stehe hier und schreibe Statistik-Tipps an die Tafel und du sitzt dort und bearbeitest Statistikaufgaben. Wo schreibe ich Statistik-Tipps?

hier *dort*

7 Ich stehe hier und schreibe Statistik-Tipps an die Tafel und du sitzt dort und bearbeitest Statistikaufgaben. Wenn ich du wäre und du wärst ich, wo im Seminarraum bin ich?

hier *dort*

8 Ich stehe hier und schreibe Statistik-Tipps an die Tafel und du sitzt dort und bearbeitest Statistikaufgaben. Wenn ich du wäre und du wärst ich, wo im Seminarraum bist du?

hier *dort*

9 Gestern war meine Arbeit im Statistikkurs eine Herausforderung; heute macht meine Arbeit in Statistik Spass. Wann war meine Arbeit herausfordernd?

gestern *heute*

10 Gestern war meine Arbeit im Statistikkurs eine Herausforderung; heute macht meine Arbeit in Statistik Spass. Wann machte meine Arbeit Spass?

gestern *heute*

11 Gestern war meine Arbeit im Statistikkurs eine Herausforderung; heute macht meine Arbeit in Statistik Spass. Wenn gestern heute wäre und heute wäre gestern, wann war meine Arbeit eine Herausforderung?

gestern heute

12 Gestern war meine Arbeit im Statistikkurs eine Herausforderung; heute macht meine Arbeit in Statistik Spass. Wenn gestern heute wäre und heute wäre gestern, wann machte meine Arbeit Spass?

gestern *heute*

13 Gestern hast du Statistikaufgaben bearbeitet; heute zögerst du beim Lösen von Statistikaufgaben. Wann hast du Statistikaufgaben bearbeitet?

gestern *heute*

14 Gestern hast du Statistikaufgaben bearbeitet; heute zögerst du beim Lösen von Statistikaufgaben. Wann hast du gezögert, Statistikaufgaben zu lösen?

gestern *heute*

15 Gestern hast du Statistikaufgaben bearbeitet; heute zögerst du beim Lösen von Statistikaufgaben. Wenn gestern heute wäre und heute wäre gestern, wann hast du Statistikaufgaben bearbeitet?

gestern *heute*

16 Gestern hast du Statistikaufgaben bearbeitet; heute zögerst du beim Lösen von Statistikaufgaben. Wenn gestern heute wäre und heute wäre gestern, wann hast du gezögert, Statistikaufgaben zu lösen?

gestern *heute*

17 Gestern habe ich Statistik-Tipps angeschrieben, heute fällt mir die Arbeit in Statistik leicht. Wann habe ich Statistik-Tipps angeschrieben?

gestern *heute*

18 Gestern habe ich Statistik-Tipps angeschrieben, heute fällt mir die Arbeit in Statistik leicht. Wann war meine Arbeit in Statistik leicht?

gestern *heute*

19 Gestern habe ich Statistik-Tipps angeschrieben, heute fällt mir die Arbeit in Statistik leicht. Wenn gestern heute wäre und heute wäre gestern, wann habe ich Statistik-Tipps angeschrieben?

gestern *heute*

20 Gestern habe ich Statistik-Tipps angeschrieben, heute fällt mir die Arbeit in Statistik leicht. Wenn gestern heute wäre und heute wäre gestern, wann war meine Arbeit in Statistik leicht?

gestern *heute*

21 Heute schreibe ich hier Statistik-Tipps, gestern habe ich dort den Ideen von zu Statistikproblemen zugestimmt. Wo habe ich geschrieben?

hier *dort*

22 Heute schreibe ich hier Statistik-Tipps, gestern habe ich dort den Ideen von zu Statistikproblemen zugestimmt. Wo habe ich zugestimmt?

hier *dort*

23 Heute schreibe ich hier Statistik-Tipps, gestern habe ich dort den Ideen von zu Statistikproblemen zugestimmt. Wenn hier dort wäre und dort wäre hier, wo habe ich geschrieben?

hier *dort*

24 Heute schreibe ich hier Statistik-Tipps, gestern habe ich dort den Ideen von zu Statistikproblemen zugestimmt. Wenn hier dort wäre und dort wäre hier, wo habe ich zugestimmt?

hier *dort*

25 Heute zögerst du hier Statistikaufgaben zu lösen, gestern hast du dort Statistikaufgaben bearbeitet. Wo hast du gezögert Statistikaufgaben zu lösen?

hier *dort*

26 Heute zögerst du hier Statistikaufgaben zu lösen, gestern hast du dort Statistikaufgaben bearbeitet. Wo hast du Statistikaufgaben bearbeitet?

hier dort

27 Heute stehe ich hier im Statistikkurs und schreibe Statistik-Tipps, gestern war ich dort im Statistikkurs und es hat Spass gemacht. Wenn hier dort wäre und dort wäre hier, wo stehe ich jetzt?

hier *dort*

28 Heute stehe ich hier im Statistikkurs und schreibe Statistik-Tipps, gestern war ich dort im Statistikkurs und es hat Spass gemacht. Wenn hier dort wäre und dort wäre hier, wo hatte ich Spass?

hier *dort*

29 Ich bin auf einem hohen Kompetenzniveau in Englisch, du auf einem niedrigen. Auf welchem Kompetenzniveau bist du in Englisch?

niedrig *hoch*

30 Ich bin auf einem hohen Kompetenzniveau in Englisch, du auf einem niedrigen. Auf welchem Kompetenzniveau bin ich in Englisch?

niedrig *hoch*

31 Ich bin auf einem hohen Kompetenzniveau in Englisch, du auf einem niedrigen. Wenn ich du wäre und du wärst ich, auf welchem Kompetenzniveau wärst du in Englisch?

gut *schlecht*

32 Ich bin auf einem hohen Kompetenzniveau in Englisch, du auf einem niedrigen. Wenn ich du wäre und du wärst ich, auf welchem Kompetenzniveau wäre ich in Englisch?

gut *schlecht*

33 Ich stehe hier und schreibe Englisch-Tipps an die Tafel und du sitzt dort und bearbeitest Englischaufgaben. Wo bearbeitest du Englischaufgaben?

hier *dort*

34 Ich stehe hier und schreibe Englisch-Tipps an die Tafel und du sitzt dort und bearbeitest Englischaufgaben. Wo schreibe ich Englisch-Tipps?

hier *dort*

35 Ich stehe hier und schreibe Englisch-Tipps an die Tafel und du sitzt dort und bearbeitest Englischaufgaben. Wenn ich du wäre und du wärst ich, wo im Seminarrraum bin ich?

hier *dort*

36 Ich stehe hier und schreibe Englisch-Tipps an die Tafel und du sitzt dort und bearbeitest Englischaufgaben. Wenn ich du wäre und du wärst ich, wo im Seminarrraum bist du?

hier *dort*

37 Gestern war meine Arbeit im Englischkurs eine Herausforderung; heute macht meine Arbeit in Englisch Spass. Wann war meine Arbeit herausfordernd?

gestern *heute*

38 Gestern war meine Arbeit im Englischkurs eine Herausforderung; heute macht meine Arbeit in Englisch Spass. Wann machte meine Arbeit Spass?

gestern *heute*

39 Gestern war meine Arbeit im Englischkurs eine Herausforderung; heute macht meine Arbeit in Englisch Spass. Wenn gestern heute wäre und heute wäre gestern, wann war meine Arbeit eine Herausforderung?

gestern *heute*

40 Gestern war meine Arbeit im Englischkurs eine Herausforderung; heute macht meine Arbeit in Englisch Spass. Wenn gestern heute wäre und heute wäre gestern, wann machte meine Arbeit Spass?

gestern *heute*

41 Gestern hast du Englischaufgaben bearbeitet; heute zögerst du beim Lösen von Englischaufgaben. Wann hast du Englischaufgaben bearbeitet?

gestern heute

42 Gestern hast du Englischaufgaben bearbeitet; heute zögerst du beim Lösen von Englischaufgaben. Wann hast du gezögert, Englischaufgaben zu lösen?

gestern *heute*

43 Gestern hast du Englischaufgaben bearbeitet; heute zögerst du beim Lösen von Englischaufgaben. Wenn gestern heute wäre und heute wäre gestern, wann hast du Englischaufgaben bearbeitet?

gestern *heute*

44 Gestern hast du Englischaufgaben bearbeitet; heute zögerst du beim Lösen von Englischaufgaben. Wenn gestern heute wäre und heute wäre gestern, wann hast du gezögert, Englischaufgaben zu lösen?

gestern *heute*

45 Gestern habe ich Englisch-Tipps angeschrieben, heute fällt mir die Arbeit in Englisch leicht. Wann habe ich Englisch-Tipps angeschrieben?

gestern *heute*

46 Gestern habe ich Englisch-Tipps angeschrieben, heute fällt mir die Arbeit in Englisch leicht. Wann war meine Arbeit in Englisch leicht?

gestern *heute*

47 Gestern habe ich Englisch-Tipps angeschrieben, heute fällt mir die Arbeit in Englisch leicht. Wenn gestern heute wäre und heute wäre gestern, wann habe ich Englisch-Tipps angeschrieben?

gestern *heute*

48 Gestern habe ich Englisch-Tipps angeschrieben, heute fällt mir die Arbeit in Englisch leicht. Wenn gestern heute wäre und heute wäre gestern, wann war meine Arbeit in Englisch leicht? *gestern*

heute

49 Heute schreibe ich hier Englisch-Tipps, gestern habe ich dort den Ideen von zu Englischproblemen zugestimmt. Wo habe ich geschrieben?

hier *dort*

50 Heute schreibe ich hier Englisch-Tipps, gestern habe ich dort den Ideen von zu Englischproblemen zugestimmt. Wo habe ich zugestimmt?

hier *dort*

51 Heute schreibe ich hier Englisch-Tipps, gestern habe ich dort den Ideen von zu Englischproblemen zugestimmt. Wenn hier dort wäre und dort wäre hier, wo habe ich geschrieben?

hier *dort*

52 Heute schreibe ich hier Englisch-Tipps, gestern habe ich dort den Ideen von zu Englischproblemen zugestimmt. Wenn hier dort wäre und dort wäre hier, wo habe ich zugestimmt?

hier dort

53 Heute zögerst du hier Englischaufgaben zu lösen, gestern hast du dort Englischaufgaben bearbeitet. Wo hast du gezögert Englischaufgaben zu lösen?

hier *dort*

54 Heute zögerst du hier Englischaufgaben zu lösen, gestern hast du dort Englischaufgaben bearbeitet. Wo hast du Englischaufgaben bearbeitet?

hier *dort*

55 Heute stehe ich hier im Englischkurs und schreibe Englisch-Tipps, gestern war ich dort im Englischkurs und es hat Spass gemacht. Wenn hier dort wäre und dort wäre hier, wo stehe ich jetzt?

hier *dort*

56 Heute stehe ich hier im Englischkurs und schreibe Englisch-Tipps, gestern war ich dort im Englischkurs und es hat Spass gemacht. Wenn hier dort wäre und dort wäre hier, wo hatte ich Spass?

hier *dort*

Study 2: Flexible social perspective-taking tasks used in German and displayed in randomized order

1 Ich stehe hier und schreibe Mathetipps an die Tafel und Schüler/innen sitzen dort und bearbeiten Matheaufgaben. Wenn ich an der Stelle der Schüler/innen wäre und die Schüler/innen an meiner Stelle: Wer bearbeitet die Matheaufgaben?

ich *die Schüler/innen*

2 Ich stehe am Fenster und unterschreibe im Klassenbuch; Schüler/innen schreiben Mathetipps auf. Wenn ich an der Stelle der Schüler/innen wäre und die Schüler/innen an meiner Stelle: Wer schreibt Mathetipps auf?

ich *die Schüler/innen*

3 Ich lese die Sachaufgabe und Schüler/innen haben die Sachaufgabe gelöst. Wenn ich an der Stelle der Schüler/innen wäre und die Schüler/innen an meiner Stelle: Wer hat die Sachaufgabe gelöst?

ich *die Schüler/innen*

4 Ich lese die Sachaufgabe und der Schüler meint, er kann die Sachaufgabe nicht. Wenn ich an der Stelle des Schülers wäre und der Schüler an meiner Stelle: Wer liest die Sachaufgabe?

ich *der Schüler*

5 Ich sitze bei einer Gruppe, die eine Aufgabe gemeinsam löst; eine Schülerin malt die Aufgabe grün aus. Wenn ich an der Stelle der Schülerin wäre und die Schülerin an meiner Stelle: Wer sitzt bei einer Gruppe?

ich *die Schülerin*

6 Ich löse eine Aufgabe und eine Schülerin gähnt. Wenn ich an der Stelle der Schülerin wäre und die Schülerin an meiner Stelle: Wer löst die Aufgabe?

ich *die Schülerin*

7 Ich zeige auf ein Dreieck und eine Schülerin malt ein Dreieck grün aus. Wenn ich an der Stelle der Schülerin wäre und die Schülerin an meiner Stelle: Wer zeigt auf das Dreieck?

ich *die Schülerin*

8 Gestern zögerten die Schüler/innen Matheaufgaben zu lösen und heute demonstriere ich die Lösung. Wenn gestern heute wäre und heute wäre gestern: Wann demonstriere ich die Lösung?

gestern *heute*

9 Gestern haben die Schüler/innen Matheaufgaben bearbeitet; heute zögern die Schüler/innen Matheaufgaben zu lösen. Wenn gestern heute wäre und heute wäre gestern: Wann haben die Schüler/innen gezögert Matheaufgaben zu lösen?

gestern *heute*

10 Gestern lösten Schüler/innen in Gruppen Matheaufgaben und heute höre ich Schüler/innen aufmerksam zu. Wenn heute gestern wäre und gestern wäre heute: Wann höre ich zu?

gestern *heute*

11 Gestern hast du Matheaufgaben bearbeitet; heute zögerst du beim Lösen von Matheaufgaben. Wenn heute gestern wäre und gestern wäre heute: Wann hast du Matheaufgaben bearbeitet?

gestern *heute*

12 Gestern hast du das Dreieck gezeichnet, heute zögerst du die Aufgabe zu lösen. Wenn heute gestern wäre und gestern wäre heute: Wann hast du das Dreieck gezeichnet?

gestern *heute*

13 Gestern hast du gemalt; heute meldest du dich oft. Wenn heute gestern wäre und gestern wäre heute: Wann hast du gemalt?

gestern *heute*

14 Gestern machten dir die Matheaufgaben Spaß; heute schaust du aus dem Fenster. Wenn heute gestern wäre und gestern wäre heute: Wann hattest du Spaß?

gestern *heute*

15 Ich stehe hier und schreibe Mathetipps an die Tafel und Schüler/innen sitzen dort und bearbeiten Matheaufgaben. Wenn hier dort wäre und dort wäre hier: Wo bearbeiten die Schüler/innen Matheaufgaben?

hier *dort*

16 Ich sitze hier am Fenster und unterschreibe im Klassenbuch; Schüler/innen schreiben dort an Tischen Mathetipps auf. Wenn hier dort wäre und dort wäre hier: Wo sitze ich?

hier dort

17 Ich bin hier bei Schüler/innen und die anderen Schüler/innen schreiben dort konzentriert. Wenn hier dort wäre und dort wäre hier: Wo bin ich?

hier *dort*

18 Ich gehe hier durch den Gang und die Schüler/innen gehen zu den Modellen dort. Wenn hier dort wäre und dort wäre hier: Wo gehe ich?

hier *dort*

19 Ich bin hier und zeichne ein Dreieck an die Tafel und der Schüler ist dort und berechnet einen Winkel. Wenn hier dort wäre und dort wäre hier: Wo ist der Schüler?

hier *dort*

20 Ich stehe hier vorn und zeige im Buch auf den Satz des Pythagoras und der Schüler steht dort hinten am Platz und langweilt sich. Wenn hier dort wäre und dort wäre hier: Wo steht der Schüler?

hier *dort*

21 Ich sitze hier und halte das Buch mit dem Satz des Pythagoras; die Schülerin sitzt dort und hält das Buch 10cm vor ihren Augen. Wenn hier dort wäre und dort wäre hier: Wo sitzt die Schülerin?

hier *dort*

22 Ich bin hier am Beamer und zeige auf ein Dreieck und eine Schülerin dort am Tisch malt ein Dreieck grün aus. Wenn hier dort wäre und dort wäre hier: Wo ist die Schülerin?

hier *dort*

Study 3: Flexible social perspective-taking tasks used in English (displayed in randomized order)

1 I am standing here writing math tips on the board and students are sitting there doing math tasks. Where are students doing math tasks?

here *there*

2 I am standing here writing math tips on the board and students are sitting there doing math tasks. Where am I writing math tips?

here *there*

3 I am standing here writing math tips and students are sitting there doing math tasks. If I were in the shoes of the students and the students were in my shoes: Who would be doing math tasks?

I *the students*

4 I am standing here writing math tips and students are sitting there doing math tasks. If I were in the shoes of the students and the students were in my shoes. Who would be writing the math tips?

I *the students*

5 Yesterday students were doing math tasks; today, students are hesitating to solve math tasks. If yesterday were today and today were yesterday: When were students doing math tasks?

yesterday *today*

6 Yesterday, students were doing math tasks; today, students are hesitating to solve math tasks. If yesterday were today and today were yesterday: When were students hesitating to solve math tasks?

yesterday *today*

Study 3: Flexible social perspective-taking tasks used in German (displayed in randomized order)

1 Ich stehe hier und schreibe Mathetipps an die Tafel und Schüler/innen sitzen dort und bearbeiten Matheaufgaben. Wo bearbeiten die Schüler/innen Matheaufgaben?

hier *dort*

2 Ich stehe hier und schreibe Mathetipps an die Tafel und Schüler/innen sitzen dort und bearbeiten Matheaufgaben. Wo schreibe ich Mathetipps?

hier *dort*

3 Ich stehe hier und schreibe Mathetipps an die Tafel und Schüler/innen sitzen dort und

bearbeiten Matheaufgaben. Wenn ich an der Stelle der Schüler/innen wäre und die Schüler/innen an meiner Stelle. Wer würde die Matheaufgaben bearbeiten?

ich *die Schüler/innen*

4 Ich stehe hier und schreibe Mathetipps an die Tafel; Schüler/innen sitzen dort und bearbeiten Matheaufgaben. Wenn ich an der Stelle der Schüler/innen wäre und die Schüler/innen an meiner Stelle. Wer würde die Mathetipps an die Tafel schreiben?

ich *die Schüler/innen*

5 Gestern haben die Schüler/innen Matheaufgaben bearbeitet; heute zögern die Schüler/innen Matheaufgaben zu lösen. Wenn gestern heute wäre und heute wäre gestern: Wann haben die Schüler/innen Matheaufgaben bearbeitet?

gestern *heute*

6 Gestern haben die Schüler/innen Matheaufgaben bearbeitet; heute zögern die Schüler/innen Matheaufgaben zu lösen. Wenn gestern heute wäre und heute wäre gestern: Wann haben die Schüler/innen gezögert Matheaufgaben zu lösen?

gestern *heute*