

# **Cognitive and social congruence between students and student tutors: An investigation of peer-assisted learning in medical school**

## **Dissertation**

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*Für meine Eltern*



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# Synopsis

## List of Abbreviations

CI = confidence interval

CFI= comparative fit index

df = degrees of freedom

M = Mean

PAL = Peer-assisted learning

RMSEA = root mean square error of approximation

SD = Standard deviation

$\chi^2$  = Chi-square

$\beta$  = beta

ZPD = Zone of proximal development



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## Abstract

*'I would definitely trust my student tutor. I trust that she can estimate her professional competence of what she does know and is able to teach us' (Loda al., 2020b, p.4).* This statement from a medical student shows that peer-assisted learning (PAL) is a well-established concept in the medical training. Moreover, PAL is the teaching of students by students. Based on the previous literature PAL is effective due to the cognitive and social congruence between students and student tutors. Cognitive congruence occurs when students and student tutors share the same language and knowledge framework. Student tutors are perceived as socially congruent by students when tutors have similar social roles and are considered role models. However, the previous literature did not consider behavioural and practical elements of cognitive and social congruence. Thus, this doctoral thesis aims to investigate cognitive and social congruence on behavioural levels.

The thesis is divided into three subprojects. First, a scoping literature review on cognitive and social congruence was conducted for an overview. Second, semi-structured interviews on cognitive and social congruence were conducted with medical students as participants, student tutors as teachers, and lecturers as supervisors. Based on the review and interviews, a novel instrument for cognitive and social congruence was developed and tested using exploratory and confirmatory factor analyses. Using this new instrument, cognitive and social congruence can be assessed and operationalised on a behavioural level from the perspectives of students and student tutors. The results reveal that cognitive congruence is represented by student tutors sharing a familiar language and similar knowledge framework and explaining topics at an appropriate level with high expertise. Social congruence was displayed by sharing similar social roles, being supportive and empathic, asking questions, experiencing an open, stress-free learning atmosphere, sharing experiences, giving tips, and enjoying the tutorial. New findings were that an open, stress-free learning atmosphere and trust in the student tutors belong to both cognitive and social congruence. Furthermore, easy and informal communication or informal contact were associated with cognitive instead of social congruence. The effectiveness of the tutorial and student tutors belongs to social congruence.

Relevant and practical recommendations for action can be derived to train student tutors based on the findings. Future research could also focus on the influence of cognitive and social congruence on further relevant PAL factors, such as small group functioning or individual learning performance.

## Zusammenfassung

*„Ich würde meiner studentischen Tutorin auf jeden Fall vertrauen. Ich vertraue ihr, dass sie ihre professionelle Kompetenz einschätzen kann, was sie weiß und dass sie uns unterrichten kann“* (Loda al., 2020b, p.4). Diese Aussage eines Medizinstudierenden zeigt, dass Peer-assisted Learning weltweit ein gut etabliertes Konzept in der medizinischen Ausbildung ist. Es repräsentiert das Unterrichten von Studierenden durch Studierende. Basierend auf der bisherigen Literatur ist Peer-assisted Learning aufgrund der kognitiven und sozialen Kongruenz zwischen Studierenden und studentischen Tutorinnen und Tutoren effektiv. Kognitive Kongruenz ist dann gegeben, wenn Studierende und studentische Tutorinnen und Tutoren einen ähnlichen Sprachgebrauch und Wissensstand haben. Studentische Tutorinnen und Tutoren werden von den Studierenden als sozial kongruent wahrgenommen, wenn erstere ähnliche soziale Rollen haben und als Vorbild angesehen werden. In der bisherigen Literatur wurden der verhaltensbezogene und praktische Aspekt der kognitiven und sozialen Kongruenz jedoch nicht berücksichtigt. Das Ziel dieser Dissertation ist daher die Untersuchung von kognitiver und sozialer Kongruenz auf der konkreten Verhaltensebene.

Die Dissertation gliedert sich in drei Teilprojekte. Zuerst wurde ein Scoping Review zur kognitiven und sozialen Kongruenz durchgeführt, um einen Überblick über die bisherige Literatur zu erhalten. Des Weiteren wurden semi-strukturierte Interviews zur kognitiven und sozialen Kongruenz durchgeführt, in denen erstmals Medizinstudierende als Teilnehmende, studentische Tutorinnen und Tutoren als Lehrende sowie Dozierende als Betreuende zu dieser Thematik befragt wurden. Auf Grundlage der Ergebnisse aus dem Review und den Interviews wurde im dritten Teil ein neues Instrument zur Erfassung von kognitiver und sozialer Kongruenz auf der konkreten Verhaltensebene entwickelt. Das Instrument wurde mithilfe von explorativen und konfirmatorischen Faktorenanalysen getestet. Durch den Einsatz des neuen Instruments können sowohl die kognitive als auch die soziale Kongruenz aus der Perspektive der Studierenden sowie der studentischen Tutorinnen und Tutoren auf der Verhaltensebene operationalisiert und bewertet werden.

Die Ergebnisse zeigen, dass die kognitive Kongruenz durch die Verwendung einer gemeinsamen Sprache sowie einer ähnlichen Wissenssebene, durch das Erklären

von Themen auf einem verständlichen Niveau und durch die hohe Expertise der studentischen Tutorinnen und Tutoren erreicht wird. Soziale Kongruenz zeigt sich durch das Teilen ähnlicher sozialer Rollen, das Stellen von direkten Fragen, das Teilen von Erfahrungen, das Geben von Tipps und durch Spaß im Tutorium. Außerdem tragen unterstützendes und empathisches Verhalten sowie eine offene und stressfreie Lernatmosphäre zur sozialen Kongruenz bei. Neue Erkenntnisse sind, dass eine offene und stressfreie Lernatmosphäre und das Vertrauen in die studentischen Tutorinnen und Tutoren sowohl zur kognitiven als auch zur sozialen Kongruenz gehören. Zudem sind das Kommunizieren und Kontaktieren in einfacher und informeller Art und Weise mit kognitiver anstelle von sozialer Kongruenz assoziiert. Die Effektivität des Tutoriums sowie der studentischen Tutorinnen und Tutoren gehören zur sozialen Kongruenz.

Aus den Ergebnissen lassen sich relevante und praktische Handlungsempfehlungen für die studentische Tutorinnen- und Tutorenausbildung ableiten. Zukünftige Forschungsprojekte sollten sich auf die Auswirkungen von kognitiver und sozialer Kongruenz auf weitere relevante PAL-Faktoren, wie das Funktionieren von Kleingruppenarbeit oder die individuelle Lernleistung, fokussieren.

## List of Publication

Accepted manuscripts:

### Manuscript 1:

Loda, T., Erschens, R., Loenneker, H., Keifenheim, K. E., Nikendei, C., Junne, F., Zipfel, S., & Herrmann-Werner, A. (2019). Cognitive and social congruence in peer-assisted learning - A scoping review. *PloS one*, *14*(9), e0222224. <https://doi.org/10.1371/journal.pone.0222224>

### Manuscript 2:

Loda, T., Erschens, R., Nikendei, C., Zipfel, S., & Herrmann-Werner, A. (2020b). Qualitative analysis of cognitive and social congruence in peer-assisted learning - The perspectives of medical students, student tutors and lecturers. *Medical education online*, *25*(1), 1801306. <https://doi.org/10.1080/10872981.2020.1801306>

### Manuscript 3:

Loda, T., Erschens, R., Nikendei, C., Giel, K., Junne, F., Zipfel, S., & Herrmann-Werner, A. (2020a). A novel instrument of cognitive and social congruence within peer-assisted learning in medical training: construction of a questionnaire by factor analyses. *BMC medical education*, *20*(1), 214. <https://doi.org/10.1186/s12909-020-02129-x>

## **Declaration/ Erklärung**

Ich erkläre, dass ich die zur Promotion eingereichte Arbeit mit dem Titel "Cognitive and social congruence between students and student tutors: An investigation of peer-assisted learning in medical school" selbständig verfasst, nur die angegebenen Quellen und Hilfsmittel benutzt und wörtlich oder inhaltlich übernommene Stellen als solche gekennzeichnet habe. Ich versichere an Eides statt, dass diese Angaben wahr sind und dass ich nichts verschwiegen habe. Mir ist bekannt, dass die falsche Abgabe einer Versicherung an Eides statt mit Freiheitsstrafe bis zu drei Jahren oder mit Geldstrafe bestraft wird.

*I hereby declare that I have produced the work entitled 'Cognitive and social congruence between students and student tutors: An investigation of peer-assisted learning in medical school', submitted for the award of a doctorate, on my own (without external help), have used only the sources and aids indicated and have marked passages included from other works, whether verbatim or in content, as such. I swear upon oath that these statements are true and that I have not concealed anything. I am aware that making a false declaration under oath is punishable by a term of imprisonment of up to three years or by a fine.*

Tübingen, den 20.10.2020

Teresa Loda



## 1. Introduction

Joseph Joubert said, 'To teach is to learn twice', which presents the basic concept for peer-assisted learning (PAL) (Raimi, 1981, p.51). PAL is a well established and explored teaching concept that has become a relevant part in medical curricula (Benè & Bergus, 2014; Burgess et al., 2016; Santee & Garavalia, 2006). As traditional teaching concept PAL is applied in numerous courses of study such as health sciences and law (Moust & Schmidt, 1994; Schmidt, 1995; Topping, 2005). In medical training PAL is a valuable teaching method and is implemented in various settings and subjects, such as problem-based learning, skills labs, anatomy, history taking, and communication skills (Blohm et al., 2015; Burgess et al., 2016; Hall et al., 2013; Hall et al., 2014).

In addition, PAL can be considered learning from each other with a mutual benefit (Benè & Bergus, 2014; Burgess et al., 2016; Herrmann-Werner et al., 2017; Santee & Garavalia, 2006). It focused on reduced distance learning so that students are taught by students who previously attended the course which they are going to teach. Often, PAL takes place as student tutorials in order to complement the usual medical curriculum. In general, these student tutorials are supervised by lecturers. 'Student tutors' are students who teach students in class (Loda et al., 2019). They also complete a didactic qualification formally initiated by a higher institutional body to become good teachers. The students who are taught and attend the student tutorials are defined as 'tutees' (Hall et al., 2013; Loda et al., 2019; Ten Cate & Durning, 2007).

Topping and Ehly (1998, p.631) defined PAL as follows:

Peer learning can be defined as the acquisition of knowledge and skill through active helping and supporting among status equals or matched companions. It involves people from similar social groupings who are not professional teachers helping each other to learn and learning themselves by so doing.

In this statement Topping & Ehly (1995) highlighted the knowledge transfer at a low educational distance level by focussing on peers and not on the traditional teacher - student relationship where the students should look up to the teacher.

Several possible forms of PAL exist, consisting of peer tutoring, peer modelling, peer education, peer counselling, peer monitoring, and peer assessment (Arndt, 2012; Topping & Ehly, 1998). Peer tutoring is probably the best known form of PAL and is characterised by the acceptance of different roles (Topping & Ehly, 1998). One person assumes the role of the tutor and the other person assumes the role of the student. Peer modelling presents the provision of a role model who shows desirable learning behaviour that should be imitated by the other group members. Peer education involves providing sensitive information from credible colleagues who identify with and understand the circumstances of the recipients. Peer counselling is about peers who do not act as professional teachers advise and discuss with other members about their problems and try to solve them by acting positive and supportive (Arndt, 2012). In peer monitoring, peers take care of their partner and his or her learning process that should be appropriate and effective (Arndt, 2012). Finally, peer assessment focuses on considering peer agreements to assess the level or value of the work of other members by the group. In this doctoral thesis, the focus is on peer tutoring.

In medical training, student tutors and students have a comparable educational level (Ten Cate & Durning, 2007). Student tutors can be the same year or level or can be cross-year or level when regarding their educational background. Student tutors with the same year or level means that they are at the same stage of their medical education as their students (Herrmann-Werner et al., 2017; Tai et al., 2016). Cross-year or level student tutors are at a more advanced stage in their medical training (Blohm et al., 2015; Herrmann-Werner et al., 2017; Weyrich et al., 2008). However, there is always a distance between the student tutor and students, as the student tutors are didactically qualified and usually have a higher level of knowledge and expertise regarding the subject.

Moreover, PAL is more than only a concept of student teaching and learning (Herrmann-Werner et al., 2017). In the PAL setting, students feel responsible for

each other and develop a common culture of learning (Herrmann-Werner et al., 2017). Students who are involved in PAL as teachers are perceived as the facilitator or role model (Bulte, 2007).

In addition, PAL is constructed based on various learning theories. In all theories, learning is based on the continuing change or modification and adaptation of previous knowledge or experiences, and the teaching serves as a method to support this process of modification and adaptation of knowledge (Ten Cate & Durning, 2007).

There are several underlying concepts of PAL:

- 1.) Vygotsky's Zone of Proximal Development
- 2.) Bandura's Theory of Social Learning
- 3.) Cognitive and Social Congruence

### **1.1 Vygotsky's Zone of Proximal Development**

The ZPD describes the distance between the current knowledge and skill level of a learner and what he or she can attain with qualified lecturer and with guidance. Thus, the term 'proximal' concerns the skills that the learner is close to know (Vygotsky, 1980). The ZPD has been defined as the 'distance between the actual level of development' and 'the level of potential development determined by problem solving' (Vygotsky, 1978, p.87).

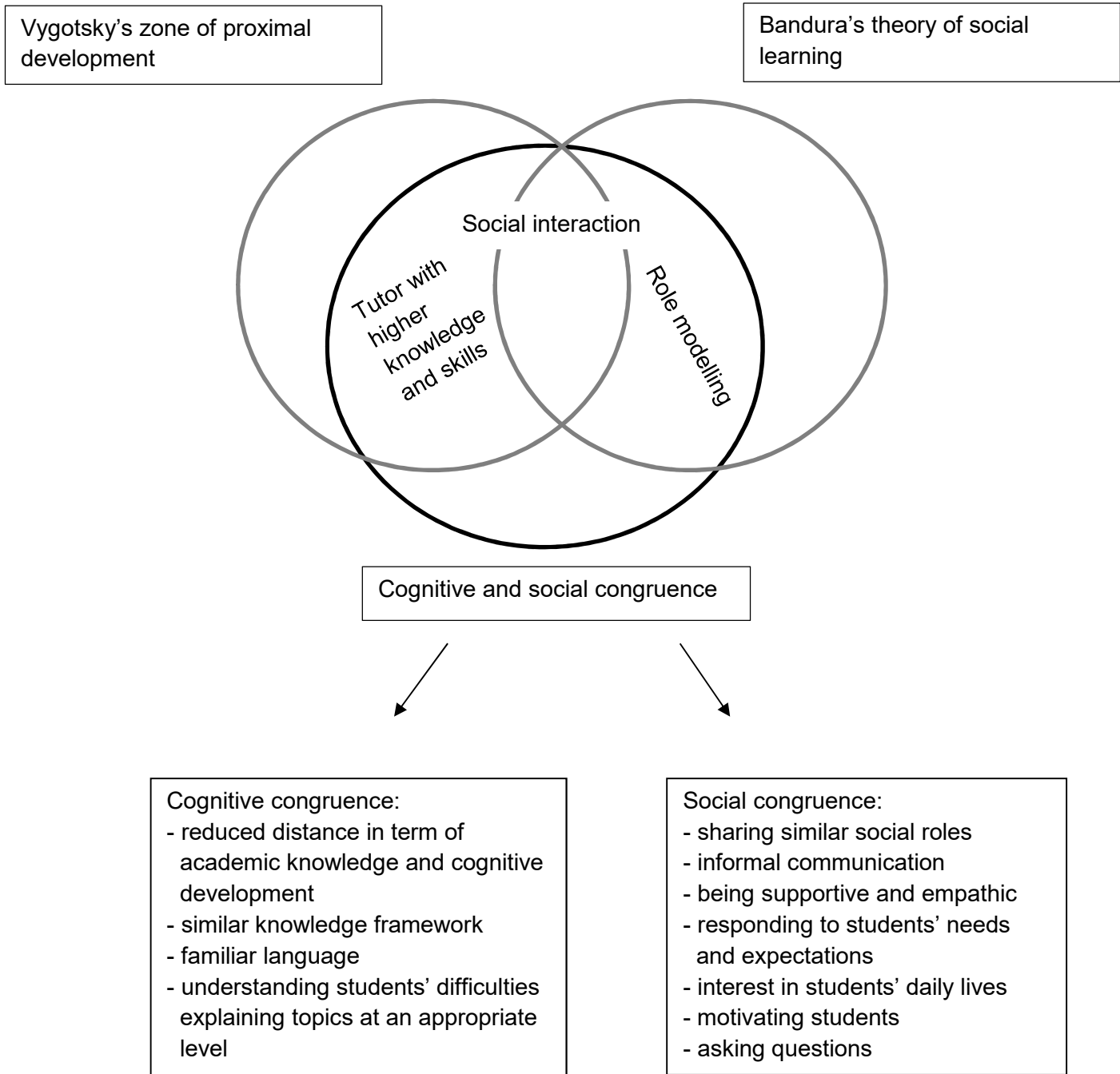
When a student is in the ZPD, he or she can get an extra boost from appropriate guidance to complete the task (Vygotsky, 1980). Here, three components are relevant in order to guide the student to successfully pass the ZPD (Vygotsky, 1980). The instructor should be someone with knowledge and skills beyond those of the learner, learner and teacher should socially interact, and supportive activities provided by the educator or a more competent colleague to assist the student (Vygotsky, 1980).

## **1.2 Bandura's Theory of Social Learning**

The Theory of Social Learning refers to the occurrence of a similarity between the behaviour of one model and that of another person under conditions where the behaviour of the model has acted as the decisive cue for the imitation reactions (Bandura & Walters, 1977). He also assumed that higher processes occur between the stimulus and reaction. His approach to modelling learning explains the rapid and efficient adoption of such behaviour. By learning from the model, humans can acquire complex social actions. The human being is influenced by models. The model can be real people but also characters in a book or actors in a film. By examining a model, one is stimulated to question certain behavioural alternatives more closely.

## **1.3 Cognitive and Social Congruence**

Several studies have postulated that PAL is effective due to the cognitive and social congruence between students and student tutors (Blohm et al., 2015; Bulte, 2007; Lockspeiser et al., 2008; Ten Cate & Durning, 2007; Watson et al., 2018). Moreover, cognitive and social congruence overlap with Vygotsky's and Bandura's theory on several points. Cognitive congruence also refers to Vygotsky's ZPD. Both theories agree that the right distance between student tutor and students is needed to effectively impart knowledge. Social congruence overlaps with Bandura's theory of social learning, as both theories focus on common learning in a social group. Figure 1 presents an overview of the underlying concepts and their intersections. In the following sections, the previous findings on cognitive and social congruence are described.



**Figure 1. Overview of the underlying concepts of peer-assisted learning and their intersections.**

### 1.3.1 Cognitive congruence

Cognitive congruence refers to the fact that students and student tutors share the same knowledge framework (Burgess et al., 2016; Cornwall, 1980; Lockspeiser et al., 2008; Schmidt & Moust, 1995; Ten Cate & Durning, 2007). The common knowledge base enables student tutors to better understand and meet learners' knowledge needs by asking targeted questions (Schmidt & Moust, 1995; Ten Cate & Durning, 2007). Studies could also show that student tutors better know what the basics are for students and what is difficult for them (Cornwall, 1980; Lockspeiser et al., 2008).

In addition to the same knowledge base, student tutors also use language that is familiar to students (Bugaj & Nikendei, 2016; Cameron et al., 2015; Cianciolo et al., 2016; Nestel & Kidd, 2003; Schmidt & Moust, 1995). Thus, student tutors can express themselves or explain difficult concepts at an appropriate level to increase the students' knowledge gain (Bugaj & Nikendei, 2016; de Menezes & Premnath, 2016; Lockspeiser et al., 2008; Schmidt & Moust, 1995).

Lockspeiser et al. (2008) indicated that student tutors present good cognitive matches that are relevant to the effectiveness of the student tutorial. Student tutors are also perceived as cognitively congruent by providing helpful advice or sharing learning experiences (Lockspeiser et al., 2008; Williams, 2016). Cognitive congruence also describes the reduced distance in academic knowledge and cognitive development between student tutors and students (Lockspeiser et al., 2008; Ten Cate & Durning, 2007; Yu et al., 2011). Thus, several studies investigated the optimal educational distance between student tutors and students in the PAL context (Hall et al., 2013; Hall et al., 2014; Stephens et al., 2016).

### *1.3.2 Social congruence*

Social congruence refers to the fact that students and student tutors share similar social roles. For example, they are both students of the same subject (Al Kawas & Hamdy, 2017; Beck et al., 2016; Bugaj & Nikendei, 2016; Cameron et al., 2015; Lockspeiser et al., 2008; Schmidt & Moust, 1995). Social congruence also contributes to the supportive and empathic behaviour of student tutors towards students by responding to their needs and expectations (Bugaj & Nikendei, 2016; Lockspeiser et al., 2008; Schmidt & Moust, 1995; Yew & Yong, 2014). Student tutors are also interested in students' daily lives (Yew & Yong, 2014). Based on social congruence, students and student tutors communicate informally during a tutorial (Lockspeiser et al., 2008; Yew & Yong, 2014).

Thus, several studies show that social congruence could decrease student anxiety and fear (Lockspeiser et al., 2008; Taylor et al., 2013; Topping & Ehly, 1998; Williams, 2016). In the PAL context, social congruence might enhance collaboration and cooperative learning (Daud, 2014; Lockspeiser et al., 2008; Mueanploy, 2016,

April). Moreover, when a student tutor was perceived as socially congruent, students were encouraged to actively participate in the class by giving feedback and asking questions, and they felt motivated (Chng et al., 2015; Khaw & Raw, 2016; Tayler et al., 2015; Ten Cate & Durning, 2007). When regarding the relationship between cognitive and social congruence, Schmidt and Moust (1995) assumed that social congruence might affect cognitive congruence in PAL.

### *1.3.3 Cognitive and social congruence as key factors for effective peer-assisted learning*

In general, cognitive and social congruence results in a powerful PAL experience, as it is perceived to be less stressful, and student tutors can refer to students' feelings of fear and uncertainty (Burgess et al., 2016; Chou et al., 2011; de Menezes & Premnath, 2016; Leeper et al., 2007; Lockspeiser et al., 2008). Moreover, cognitive and social congruence contribute to positive outcomes in PAL, including being more approachable and more interested and demonstrating better learning performance (Eller et al., 2014; Garcia-Melgar, 2015; Tayler et al., 2015).

Williams et al. (2011) investigated whether differences in cognitive and social congruence exist depending on the behaviour of students or student tutors. They found some variances in cognitive and social congruence that were explained by the differences in the behaviour of the student tutors (Williams et al., 2011). Several studies have assumed that the proximity in stages of medical training between the student tutor and students demonstrated an influence on cognitive and social congruence with a negative correlation (Hall et al., 2013; Hall et al., 2014; Stephens et al., 2016; Ten Cate & Durning, 2007).

Cognitive and social congruence was first investigated by Schmidt and Moust (1995) as a theoretical model of tutor performance in an actual teaching session. In their theoretical model, cognitive and social congruence in addition to subject-matter expertise were correlated with the functioning of small student groups, time spent on studying individually, and academic success (Schmidt & Moust, 1995; J. C. Williams, 2012). When regarding the relationship between these factors, the theoretical model indicated that higher social congruence and higher subject-matter expertise could

enhance cognitive congruence among student tutors (Schmidt & Moust, 1995; Zumbach, 2003). According to the authors, increased cognitive congruence contributed to better functioning of small student groups and greater performance, better examination results, higher intrinsic motivation, and more time spent on individual study (Schmidt & Moust, 1995; Zumbach, 2003).

Furthermore, Lockspeiser et al. (2008) investigated cognitive and social congruence in a medical programme with second-year medical students as student tutors and first-year students as participants. The participants reported that their student tutors were able to anticipate their problems and supported them in understanding difficult concepts and that they shared their experiences and strategies. Thus, student tutors assisted first-year students in overcoming their learning difficulties (Lockspeiser et al., 2008; J. Williams, 2012).

Watson et al. (2018) investigated cognitive and social congruence in an online course using a case-based learning approach. The results of the qualitative analysis revealed that the facilitator used cognitive and social congruence strategies to achieve course goals, such as modelling the case analysis process and improving students' problem solving. Although the authors only analysed the facilitator's perspective, the results indicated that cognitive and social congruence also play a relevant role in online courses (Watson et al., 2018). Further studies about cognitive and social congruence in a peer-teaching context have attempted to identify the optimal distance along a 'peer-teaching spectrum' regarding the matching of cognitive and social congruence between tutors and students by comparing the assessment of students when taught by student tutors, staff tutors, or junior doctors (Hall et al., 2013; Hall et al., 2014; Stephens et al., 2016).

## **2. Aim of the Study**

Several studies have strengthened evidence of the increasing relevance of cognitive and social congruence in PAL by demonstrating the effectiveness of student tutorials when the student tutor was perceived as cognitively and socially congruent by students (Aggarwal, 2013; Beck et al., 2016; Bugaj & Nikendei, 2016; Bulte, 2007). However, these two concepts were not often operationalised in these studies and



might be considered more like a kind of 'black box', as no practical evidence exists of both constructs at a behavioural level (Beck et al., 2016).

Nevertheless, several methods exist in the literature to measure cognitive and social congruence (Hall et al., 2013; Lockspeiser et al., 2008; Tayler et al., 2015; Vaughan & Macfarlane, 2015; Yew & Yong, 2014). Schmidt and Moust (1995), for example, developed items to measure cognitive and social congruence that were found to be reliable and valid (Schmidt & Moust, 1995; J. C. Williams, 2012). However, previous studies did not consider the behavioural and practical part of cognitive and social congruence (Beck, 2016). Student tutors seemed to influence cognitive and social congruence by their behaviour, as J. C. Williams (2012) found variances in the student tutors' behaviour that affected cognitive and social congruence. Furthermore, no empirical evidence indicates how student tutors and students could become socially and cognitively congruent.

Thus, this study aims to investigate cognitive and social congruence with a focus on the behavioural aspects of student tutors and students. To answer this general research question on cognitive and social congruence, the following approach was taken:

1. A scoping literature review was conducted on cognitive and social congruence.
2. Semi-structured interviews were conducted on cognitive and social congruence with students, student tutors, and teachers who were involved in PAL.
3. A questionnaire was constructed to assess cognitive and social congruence using exploratory and confirmatory factor analyses.

The following research questions were addressed in these three subprojects:

Question 1: How could cognitive and social congruence be defined and operationalised on a behavioural level in peer tutoring?

Question 2: How could cognitive and social congruence be assessed on a behavioural perspective?

Question 3: How cognitively and socially congruent were student tutors perceived as by their students?

Question 4: How did cognitive and social congruence affect the role of the student tutors in the student tutorial and, generally, in medical training?

Table 1 provides an overview of the subprojects and which research questions the single subprojects answer.

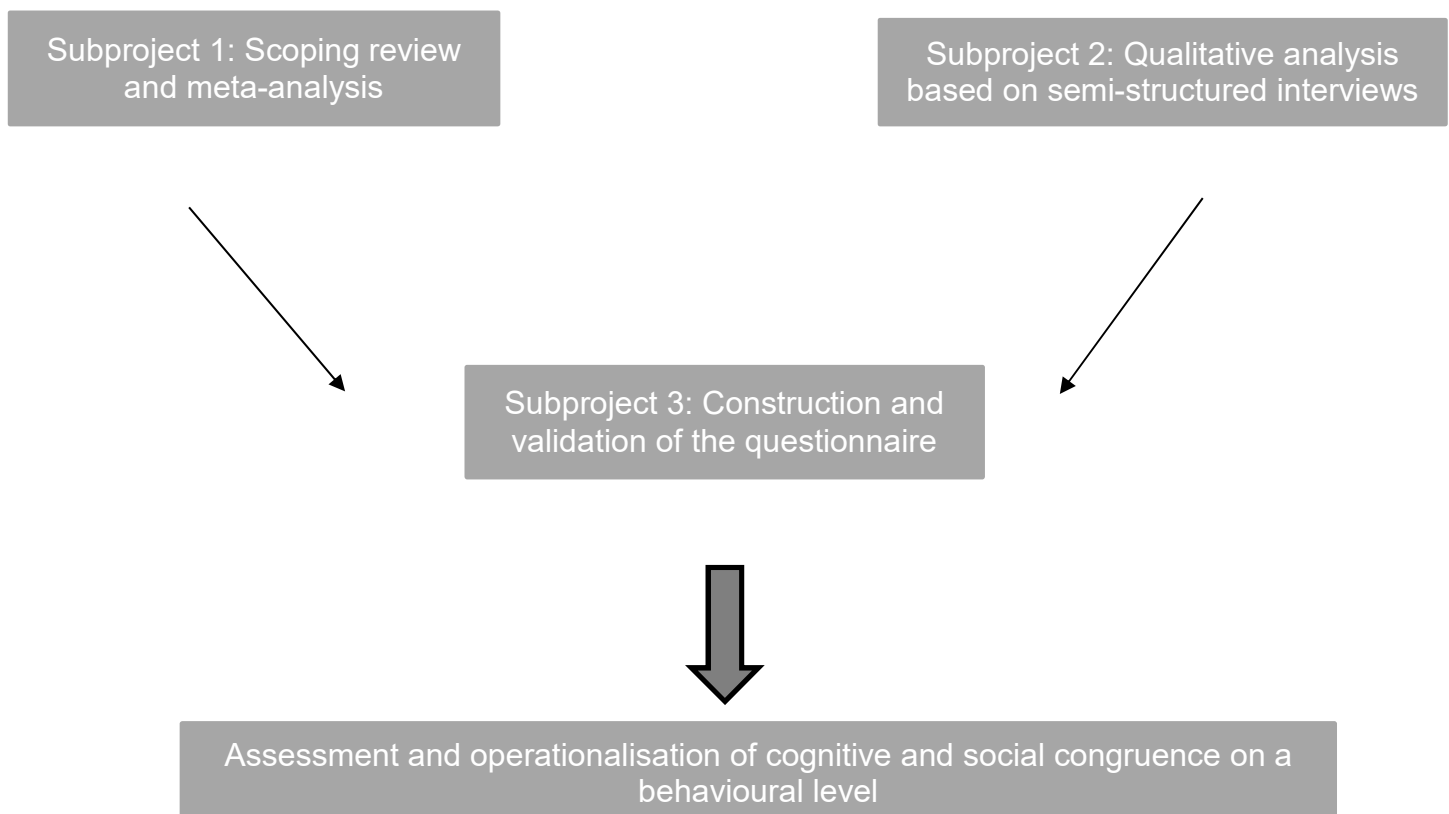
**Table 1. Overview of the subprojects addressing the research questions**

Subproject	Manuscript	Analysis type	Sample	Outcome/aim	Research questions
1	Cognitive and social congruence in peer-assisted learning – A scoping review	Review and meta-analytic pooling	Students and student tutors	Previous findings	Question 1 Question 3
2	Qualitative analysis of cognitive and social congruence in peer-assisted learning – The perspectives of medical students, student tutors and lecturers	Qualitative: semi-structured interviews	Medical students and student tutors lecturers	Students', tutors' and teachers' perspectives	Question 1 Question 2 Question 4
3	A novel instrument of cognitive and social congruence within peer-assisted learning in medical training: Construction of a questionnaire by factor analyses	Quantitative: exploratory and confirmatory factor analysis	Medical students and student tutors	Development of the questionnaire	Question 1 Question 2 Question 3 Question 4

### 3. Project Overview and Summary of Results

The thesis consists of three subprojects that are built systematically on the content of the previous subproject and investigate the concept of cognitive and social congruence (Figure 2).

#### Assessment and Operationalisation of Cognitive and Social Congruence



**Figure 2. Assessment and operationalisation of cognitive and social congruence**

The scoping review and meta-analytic pooling provided an overview of the previous results on cognitive and social congruence in literature and how they were assessed. This research was used to create interview guidelines for conducting semi-structured interviews. The qualitative analysis of the semi-structured interviews delivered further relevant aspects of cognitive and social congruence by regarding the perspectives of all those involved in the process of cognitive and social congruence in PAL, including students, student tutors, and lecturers. Based on these results of the cognitive and social congruence, a questionnaire was developed to operationalise cognitive and

social congruence on a behavioural level. Table 2 provides an overview of the three subprojects and the results in more detail (please see p. 31).

### **3.1 Subproject 1 (Manuscript 1)**

The full title of the first manuscript is 'Cognitive and Social Congruence in Peer Assisted Learning: A Scoping Review'. Subproject 1 presents a scoping review and meta-analytic pooling of studies focused on cognitive and social congruence in PAL. The review followed the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA; Liberati et al., 2009; Moher et al., 2009).

As the plan was to create interview guidelines and develop a questionnaire on cognitive and social congruence, the review also focused on instruments that assessed cognitive and social congruence or items that were associated with them. Most previous studies used the self-reported questionnaire adapted by Schmidt and Moust (1995). Further items relating to cognitive congruence were the use of time, delivery, and relevance of the content (Hall et al., 2013; Hall et al., 2014; Stephens et al., 2016; Tayler et al., 2015). Items relating to social congruence were enjoyment and approachability (Hall et al., 2013; Hall et al., 2014; Stephens et al., 2016; Tayler et al., 2015). In the meta-analytic pooling, student tutors were perceived as cognitively and socially congruent with  $M_{weighted} = 3.84$  (range of  $M_{weighted} = 2.69-4.56$ ) for cognitive and  $M_{weighted} = 3.95$  (range of  $M_{weighted} = 2.33-4.57$ ) for social congruence. Further results indicated that student tutors were perceived as more cognitively and socially congruent than faculty or consultant teachers in the PAL context (Hall et al., 2013; Hall et al., 2014; Tayler et al., 2015). However, the level of cognitive and social congruence might differ depending on the student tutor (Williams et al., 2011). In general, both cognitive and social congruence were found to be key factors in PAL, as they affected group performance and study achievement (Schmidt & Moust, 1995; J. C. Williams, 2012).

### **3.2 Subproject 2 (Manuscript 2)**

The full title of the second manuscript is 'Qualitative Analysis of Cognitive and Social Congruence in Peer-assisted Learning: The Perspectives of Medical Students,

Student Tutors and Lecturers'. Subproject 2 consisted of the results based on the qualitative analysis of semi-structured interviews focused on cognitive and social congruence. The interview guidelines based on the findings of the review and were adapted to the corresponding perspective of (1) medical students as participants in tutorials, (2) student tutors as teachers in tutorials, and (3) lecturers as supervisors. The categories of the knowledge base, high expertise of student tutors, same language, and effective knowledge transfer were found for cognitive congruence. The categories of a relaxed learning atmosphere, sharing social roles, empathic and supportive behaviour, sharing experiences, understanding difficulties, and enjoying the tutorial belong to social congruence.

New findings were that a relaxed learning atmosphere belongs to social congruence and trust in the student tutor was represented in both concepts at different levels. Trust in the student tutor belongs to social congruence when considered on an interpersonal level, where students could admit their uncertainty or reveal private problems. When assessed for cognitive congruence, students trusted the student tutor in his/her knowledge and skills with a focus on the content at the professional level. Furthermore, the results of the different perspectives of students, student tutors, and lecturers indicated that student tutors may represent the role of mediator to enhance the relationship and communication between students and lecturers.

### **3.3 Subproject 3 (Manuscript 3)**

The full title of the third manuscript is 'A Novel Instrument of Cognitive and Social Congruence within Peer-assisted Learning in Medical Training: Construction of a Questionnaire by Factor Analyses'. Subproject 3 presents a newly developed questionnaire on cognitive and social congruence and its examination using exploratory and confirmatory factor analyses. The development of the questionnaire was based on the instruments and items previously found in the literature (Subproject 1) and on the results of the semi-structured interviews (Subproject 2). The questionnaire measured cognitive and social congruence from the perspectives of the students and student tutors.

The exploratory factor analysis resulted in a two-factor solution with cognitive and social congruence as confirming factors. The confirmatory factor analysis also confirmed the two-factor solution ( $\chi^2$  (208,  $N = 149$ ) = 298.29,  $p < .001$ ;  $\chi^2/df = 1.434$  ( $\leq 2.5$ );  $RMSEA = 0.054$  (90% CI[0.040, 0.067];  $\leq 0.06$ ); CFI = 0.924 ( $\geq 0.90$ )). The associations of the items with cognitive and social congruence were primarily in line with the literature. New findings were that an open and non-judgemental learning atmosphere and easy and informal communication belong to cognitive congruence instead of social congruence. Furthermore, the results indicated that the effectiveness of the tutorial and student tutor was also associated with social congruence and not just cognitive congruence.

**Table 2. Overview of the results by subproject**

Subproject	Aims	Methods	Results
<p>1) A scoping literature review on cognitive and social congruence</p>	<ul style="list-style-type: none"> <li>- Overview of cognitive and social congruence, including meta-analytic pooling</li> <li>- Assessment of cognitive and social congruence (based on self-reported instruments)</li> <li>- Possible characteristics/competencies of student tutors to be perceived as cognitively and socially congruent</li> </ul>	<ul style="list-style-type: none"> <li>- Systematic literature research with meta-analytic pooling according to PRISMA guidelines and PICO approach with databases, such as PubMed, PsycINFO, ERIC, and Google Scholar for peer-reviewed articles published between 1993 and February 2018</li> <li>- 758 studies were identified</li> <li>- 16 studies were included, and 14 studies assessed cognitive and social congruence directly using questionnaires, two studies measured these two constructs with associated items</li> <li>- Interrater reliability: Cohen's kappa = 0.767</li> <li>- Weighted mean values of cognitive and social congruence were calculated based on simple size and a five-point Likert scale</li> </ul>	<ul style="list-style-type: none"> <li>- Most studies used the self-reported questionnaire adapted by Schmidt and Moust (1995)</li> <li>- Further items were the use of time, delivery, relevance of content, enjoyment, and approachability</li> <li>- The weighted mean value of cognitive congruence was <math>M = 3.84</math> with a range from 2.69 to 4.56</li> <li>- The weighted mean value of social congruence was <math>M = 3.95</math> with a range from 2.33 to 4.57</li> <li>- Sample sizes ranged from <math>N = 77</math> to 12,358</li> <li>- Student tutors were perceived as more cognitively and socially congruent than faculty or consultant tutors (junior doctors)</li> <li>- Cognitive congruence is influenced by social congruence; <math>\beta = 0.28 - 0.51</math></li> <li>- Significant differences in cognitive and social congruence between student tutors but not semesters</li> <li>- Cognitive congruence is influenced by student tutors' years of experience or educational qualifications</li> </ul>

Subproject	Aims	Methods	Results
<p>2) Semi-structured interviews on cognitive and social congruence with students, student tutors, and teachers</p>	<ul style="list-style-type: none"> <li>- Investigation of cognitive and social congruence from the perspective of students as participants, student tutors as teachers, and lecturers as supervisors</li> <li>- Cognitive and social congruence on a behavioural level in student tutorials</li> <li>- Focus on students' and student tutors' relationships and the teaching tutorial</li> </ul>	<ul style="list-style-type: none"> <li>- Semi-structured interview guide was constructed using the SPSS method by Helferrich</li> <li>- Interview guide consisted of open-ended questions, followed by more targeted ones</li> <li>- Students, student tutors, and teachers answered the same questions, from their respective perspectives</li> <li>- Data analysis based on the qualitative content analysis by Mayring using MAXQDA</li> </ul>	<ul style="list-style-type: none"> <li>- Participants: <math>N = 13</math> medical students, <math>N = 10</math> student tutors, and <math>N = 6</math> lecturers</li> </ul> <p>In line with previous literature:</p> <ul style="list-style-type: none"> <li>- Categories for cognitive congruence: knowledge base, high expertise of student tutors, same language, and effective knowledge transfer</li> <li>- Categories for social congruence: asking questions directly, motivation, sharing similar roles, empathic and supportive behaviour of student tutors, sharing experiences, giving tips, understanding difficult topics, and enjoying the tutorial</li> </ul> <p>New findings:</p> <ul style="list-style-type: none"> <li>- New category for social congruence: relaxing learning atmosphere</li> <li>- Category for cognitive and social congruence: trust in the student tutor</li> <li>- Student tutor as the central connector between students and teachers</li> </ul>
<p>3) Construction of a questionnaire that assesses cognitive and social congruence using exploratory and confirmatory factor</p>	<ul style="list-style-type: none"> <li>- Operationalisation of cognitive and social congruence on the behavioural level of students and student tutors using a newly developed questionnaire</li> </ul>	<ul style="list-style-type: none"> <li>- Quantitative questionnaire survey</li> <li>- Medical students and student tutors were invited to participate</li> <li>- Survey was based on the instrument by Schmidt and Moust (1995) and Vaughan and Macfarlane (2015)</li> </ul>	<ul style="list-style-type: none"> <li>- <math>N = 676</math> medical students participated; 22.1% were student tutors</li> <li>- 59.4% were female, mean age <math>24.17 \pm 3.84</math></li> <li>- Exploratory factor analysis: <ul style="list-style-type: none"> <li>o KMO value = 0.96</li> </ul> </li> </ul>



Subproject	Aims	Methods	Results
analyses	<ul style="list-style-type: none"> <li>- Construction of this questionnaire using factor analysis</li> </ul>	<ul style="list-style-type: none"> <li>- 7 items were developed based on the literature review and semi-structured interviews (Subprojects 1 and 2)</li> <li>- Final questionnaire consisted of 26 items on a five-point Likert scale (strongly disagree to strongly agree)</li> <li>- To assign items to factors of cognitive and social congruence, exploratory and confirmatory factor analyses were conducted</li> <li>- Exploratory factor analysis: <ul style="list-style-type: none"> <li>o Robust maximum likelihood was used for parameter estimation</li> <li>o Principal component analysis was the method of extraction</li> <li>o Varimax rotation was the method of rotation</li> <li>o Kaiser criterion/eigenvalue rule, scree plot to determine factors</li> </ul> </li> <li>- Confirmatory factor analysis: <ul style="list-style-type: none"> <li>o Chi-square test <ul style="list-style-type: none"> <li>o Quotient of chi-square test and degrees of freedom <math>\leq 2.5</math></li> </ul> </li> <li>o RMSEA <math>\leq 0.06</math></li> <li>o CFI <math>\geq 0.90</math></li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>o Bartlett's test of sphericity = <math>\chi^2</math> (231, <math>N = 527</math>) = 5397.75, <math>p &lt; .001</math></li> <li>o Two-factor solution with Eigenvalue (1) = 9.92 Eigenvalue (2) = 1.32</li> <li>o Overall variance = 51.07%</li> <li>- Confirmatory factor analysis: <ul style="list-style-type: none"> <li>o KMO value = 0.92</li> <li>o Bartlett's test of sphericity = <math>\chi^2</math> (276, <math>N = 149</math>) = 1346.92, <math>p &lt; .001</math></li> <li>o Two-factor solution with Eigenvalue (1) = 10.80 Eigenvalue (2) = 1.42</li> <li>o Overall variance = 50.91%</li> <li>o Chi-square test: <math>\chi^2</math> (208, <math>N=149</math>) = 298.29, <math>p &lt; .001</math></li> <li>o Quotient: <math>\chi^2/df = 1.434</math></li> <li>o RMSEA = 0.054 (90% CI, 0.040;0.067)</li> <li>o CFI = 0.924</li> </ul> </li> <li>- Cognitive congruence: <ul style="list-style-type: none"> <li>o Factor loadings: 0.46–0.79</li> <li>o <math>M_{students} = 4.01 \pm 0.54</math></li> <li>o <math>M_{tutors} = 4.15 \pm 0.53</math></li> </ul> </li> </ul>

Subproject	Aims	Methods	Results
		<ul style="list-style-type: none"> <li>- Prerequisites for both analyses were given (e.g. checking correlation matrix, Kaiser-Meyer-Olkin, and Bartlett's test of sphericity)</li> <li>- Reliability was tested using Cronbach's alpha coefficient</li> </ul>	<ul style="list-style-type: none"> <li>○ Cronbach's alpha = 0.817 for students; 0.842 for student tutors</li> <li>- Social congruence:               <ul style="list-style-type: none"> <li>○ Factor loadings: 0.38–0.80</li> <li>○ <math>M_{students} = 3.83 \pm 0.60</math></li> <li>○ <math>M_{tutors} = 4.23 \pm 0.50</math></li> <li>○ Cronbach's alpha = 0.913 for students; 0.927 for student tutors</li> </ul> </li> <li>New findings:               <ul style="list-style-type: none"> <li>- Open and non-judgemental learning atmosphere, easy and informal communication belong to cognitive congruence</li> <li>- Social congruence influence the effectiveness of the tutorial</li> </ul> </li> </ul>

Notes: df = degrees of freedom; RMSEA = root mean square error of approximation; CFI = Comparative Fit Index.

## **4. Discussion**

This doctoral thesis aims to investigate cognitive and social congruence with a focus on the behavioural aspects of student tutors and students. To operationalise cognitive and social congruence, this doctoral thesis includes a scoping review of cognitive and social congruence and semi-structured interviews on cognitive and social congruence from the perspectives of student tutors, students, and teachers. In addition, the thesis presents the construction of a questionnaire assessing these constructs using conducting exploratory and confirmatory factor analyses. In the following sections, the results of the three manuscripts are discussed based on the research questions.

### **4.1 Operationalisation and Assessment of Cognitive and Social Congruence on a Behavioural Level (Questions 1 and 2)**

Based on the results of the three subprojects, cognitive congruence focuses on knowledge transfer in student tutorials between student tutors and students. Student tutors were perceived to be cognitively congruent when they shared the same knowledge base as the students (Burgess et al., 2016; Cornwall, 1980; Lockspeiser et al., 2008; Schmidt & Moust, 1995; Ten Cate & Durning, 2007). Furthermore, they use a similar and familiar language in class (Bugaj & Nikendei, 2016; Cameron et al., 2015; Nestel & Kidd, 2003; Schmidt & Moust, 1995). This is in line with the definition by Moust and Schmidt (1994) that cognitive congruence represents the ability to express oneself in the language of the students, using the same concepts.

Social congruence describes the relationship between student tutors and students in PAL by indicating that they share similar roles, such as both being medical students. These results again confirm the definition of social congruence that student tutors and students have an informal relationship and that student tutors exhibit an attitude of personal interest and caring (Moust & Schmidt, 1994).

As already reported by many studies, cognitive congruence could be constructed using similar language and by sharing the same knowledge base (Bugaj & Nikendei, 2016; Cameron et al., 2015; Cianciolo et al., 2016; Lockspeiser et al., 2008; Nestel &

Kidd, 2003; Schmidt & Moust, 1995; Ten Cate & Durning, 2007). Student tutors are able to better express themselves at the students' level of knowledge (De Rijdt et al., 2012; Lockspeiser et al., 2008; Schmidt & Moust, 1995). Simultaneously, student tutors are expected to have a high level of expertise. Additionally, students prefer informal contact with the student tutor; thus, they view them as cognitively congruent. The students also experience a stress-free learning atmosphere when they perceived the student tutor to be cognitively congruent (Burgess et al., 2016; de Menezes & Premnath, 2016; Leeper et al., 2007). Thus, students are not afraid to tell the student tutor if they did not understand something. In contrast to the previous literature, Subproject 3 showed that the kind of communication informally and easily contributed to cognitive congruence and not to social congruence (Bugaj & Nikendei, 2016; Lockspeiser et al., 2008; Schmidt & Moust, 1995; Yew & Yong, 2014).

Social congruence could be created by the fact that student tutors give helpful and constructive feedback and that they are considered role models (Chng et al., 2015; Ten Cate & Durning, 2007). Furthermore, students and student tutors share similar roles, such as being medical students, which indicates social congruence (Al Kawas & Hamdy, 2017; Beck et al., 2016; Cameron et al., 2015; Lockspeiser et al., 2008; Schmidt & Moust, 1995). Social congruence is associated with the effectiveness of the student tutorial and the student tutor (e.g. student tutors had successfully passed the course; (Chou et al., 2013; Lockspeiser et al., 2008; Schmidt & Moust, 1995).

In line with the literature, the student tutor should support the students and be interested in the students as learners and their problems and create social congruence (Moust & Schmidt, 1994; Yew & Yong, 2014). Thus, social congruence allows for the development of a trustful learning base, such as asking questions directly, as reported by the involved students (Allen & Eby, 2003). In addition, student tutors are perceived to be socially congruent when they exhibit empathic behaviour, are open and approachable, and take time for questions (Bugaj & Nikendei, 2016; Dioso-Henson, 2012; Lockspeiser et al., 2008; Schmidt & Moust, 1995; Yew & Yong, 2014). Social congruence is also strengthened when student tutors share their experiences and provide tips.

## **4.2 Student Tutors' Level of Cognitive and Social Congruence Rated by Students (Question 3)**

In meta-analytic pooling (Subproject 1), the results demonstrated that student tutors are perceived as cognitively congruent with a mean score of 3.84 (range: 2.69-4.56) and as socially congruent with a mean score of 3.95 (range: 2.33-4.57) in the previous literature. In the assessment of cognitive and social congruence using the newly developed questionnaire (Subproject 3), high levels of cognitive and social congruence were reported by the students with a mean score of 4.01 (SD = 0.54) for cognitive congruence and 3.83 (SD = 0.60) for social congruence. These results are in line with student ratings of cognitive and social congruence in previous studies (De Rijdt et al., 2012; Hall et al., 2013; Schmidt & Moust, 1995; Stephens et al., 2016). This survey was the first to also measure the perspective of the student tutors regarding cognitive and social congruence quantitatively. Thus, student tutors rated similar levels of cognitive and social congruence with a mean score of 4.15 (SD = 0.53) for cognitive congruence and 4.23 (SD = 0.50) for social congruence when compared to student ratings of student tutors in previous studies (Hall et al., 2014; Stephens et al., 2016; Tayler et al., 2015).

In Subproject 1, the ranges of cognitive and social congruence were observed. These discrepancies could be explained through studies trying to find the optimal distance between students and student tutors to be cognitively and socially congruent (Hall et al., 2014; Stephens et al., 2016; Tayler et al., 2015). Hall et al. (2014) compared cognitive and social congruence between senior medical students and junior doctors when they taught medical students in a standardised cross-over setting (Hall et al., 2014). The results revealed that medical students perceived senior medical students as more cognitively and socially congruent than junior doctors, confirming that tutors generally should be at a similar level (Hall et al., 2014).

Stephens et al. (2016) investigated the peer-teaching spectrum by comparing the levels of cognitive and social congruence between third-, fourth-, and fifth-year medical students and junior doctors teaching second-year medical students in a neuroanatomy class. Again, medical students more highly rated the level of cognitive and social congruence for teachers at a similar level including third- and fourth-year

medical students. Fifth-year medical students and junior doctors received lower scores in the feedback criteria of cognitive and social congruence. Hence, fifth-year medical students were rated as significantly higher than junior doctors. When comparing the third- and fourth-year medical students, no significant differences were found in cognitive and social congruence, indicating that the optimal distance between student tutors and students might be one or two years of medical training.

#### **4.3 Cognitive and Social Congruence on Student Tutors' Roles in Medical Training (Question 4)**

Student tutorials present a relevant key element in medical training (Bugaj & Nikendei, 2016; Herrmann-Werner et al., 2017; Vaughan & Macfarlane, 2015). In student tutorials, knowledge is efficiently imparted to the students with a knowledge gain of about 18% (Huhn et al., 2015; Stephens et al., 2016; Tsang et al., 2013). This doctoral thesis revealed that cognitive congruence could increase the knowledge gain of students when taught by student tutors (Subprojects 1 to 3). From a learning theory viewpoint, knowledge gain also depends on student motivation and self-confidence (Topping & Ehly, 1998). Based on the results of Subproject 2, student tutors could enhance student motivation and encourage students concerning their skills and learning (Al Kawas & Hamdy, 2017). The results of the qualitative analysis (Subproject 2) also showed that social congruence might influence whether students feel motivated by student tutors.

In general, the social role of student tutors is relevant, as student tutors deal with students as individuals during tutorials (Beck et al., 2016; Cameron et al., 2015; Meller et al., 2013). Thus, empathy and individual support present relevant factors concerning efficiency (Chng et al., 2015; Ten Cate & Durning, 2007; Yew & Yong, 2014). In Subprojects 2 and 3, social congruence reflects empathy and individual support by student tutors who provide experiences and tips or take time for questions (Lockspeiser et al., 2008; Ten Cate & Durning, 2007).

The results of Subproject 2 indicated that students and student tutors might underestimate these factors of empathy and individual support because they perceive them unconsciously. However, the lecturers were more aware of these

factors and the implementation of them in the tutorials by student tutors. The lecturers highlighted that student tutors are much closer to students, and students are less afraid of the student tutors as teachers (Williams, 2016). Thus, the question arises regarding whether student tutors might act as mediators between students and teachers based on the perceived level of cognitive and social congruence.

#### **4.4 Novel Findings Regarding Cognitive and Social Congruence**

Based on this doctoral thesis, several novel findings regarding cognitive and social congruence were discovered. According to Subproject 3, an open and non-judgemental learning atmosphere also belongs to cognitive congruence, and not only social congruence, as reported in the literature (Lockspeiser et al., 2008; Masters et al., 2013; Schmidt & Moust, 1995; Yew & Yong, 2014). Similar results were also found regarding a stress-free and relaxing learning atmosphere, as it loaded on both constructs (Subprojects 2 and 3). Hence, the factor of entertainment regarding the learning atmosphere was associated with social congruence (Subproject 2).

In contrast to previous findings, having easy and informal communication in the tutorial and preferring informal contact with the student tutor were presented as relevant factors for cognitive congruence (Subproject 3) rather than social congruence (Lockspeiser et al., 2008; Masters et al., 2013; Schmidt & Moust, 1995; Yew & Yong, 2014). These different results of cognitive and social congruence might depend on the focus of the students. Students aim to determine how to best impart knowledge in tutorials, which is associated with cognitive congruence. They attain this aim by having an open, stress-free learning atmosphere and informal contact with the student tutor. Informal communication is part of the knowledge transfer and, thus, is also associated with cognitive congruence. Moreover, as the learning atmosphere in tutorials consists of entertaining aspects, it is also a relevant factor of social congruence.

Most studies have reported that peer teaching is effective due to cognitive and social congruence (Bulte, 2007; Cianciolo et al., 2016; Hall et al., 2013; Huhn, 2015; Lockspeiser et al., 2008; Schmidt & Moust, 1995). The results of this doctoral thesis specify the reasons cognitive and social congruence contribute to a powerful learning

experience. Cognitive congruence accounts for effective knowledge transfer as students achieve higher knowledge gain while the student tutors themselves progress as students in their training. In contrast to the previous literature, the effectiveness of a tutorial in general and the effectiveness of the student tutor might belong to social congruence alone (Hall et al., 2013; Khaw & Raw, 2016). The fact that the student tutor was perceived as socially congruent when he or she was able to explain student topics and understood the students' difficulties strengthens this assumption. This result of social congruence might be explained by various communication models because the social level seems to affect the content level of the tutorials and, thus, represents a crucial element of the effectiveness of student tutors and tutorials (Thun, 1981; Watzlawick et al., 1969).

Trust in the tutor was reported as a key element for cognitive and social congruence in Subproject 2. Interviewed students indicated that they trust their student tutors regarding the content and professional level. They reported their trust in the student tutors' knowledge and skills, which was associated with cognitive congruence (Cornwall, 1980; Lockspeiser et al., 2008; Schmidt & Moust, 1995). When regarding trust in the context of social congruence, the focus was on the interpersonal level, where students could reveal their uncertainty or discuss private problems with the student tutor (Allen & Eby, 2003; Dioso-Henson, 2012).

#### **4.5 Influencing Factors of Cognitive and Social Congruence in Peer-assisted Learning**

In line with the previous literature, cognitive and social congruence present a level of knowledge and the type of relationship between student tutors and students. Based on the results in this doctoral thesis (Subprojects 1 to 3), both constructs contribute to the effectiveness of student tutorials, as already reported in many studies (Blohm et al., 2015; Bulte, 2007; Lockspeiser et al., 2008; Ten Cate & Durning, 2007; Watson et al., 2018).

The results of this doctoral thesis may partly explain the theoretical model by Schmidt and Moust (1995) who demonstrated that cognitive congruence, influenced by social congruence and expertise, led to better functioning of small student groups, higher



intrinsic motivation, more time spent on individual study, and better performance results. In Subproject 2, students reported that they expected their student tutor to have high expertise and, thus, saw them as cognitively congruent. Furthermore, the results revealed that knowledge transfer was quite effective in tutorials for students and the student tutors. Students achieved a higher knowledge gain and experienced learning success on exams, whereas student tutors also progressed in their medical training. In addition, student tutors who were perceived as socially congruent created a relaxing learning environment, which might have affected the better functioning of small groups. Moreover, student tutors could raise student motivation due to social congruence (Figure 3).

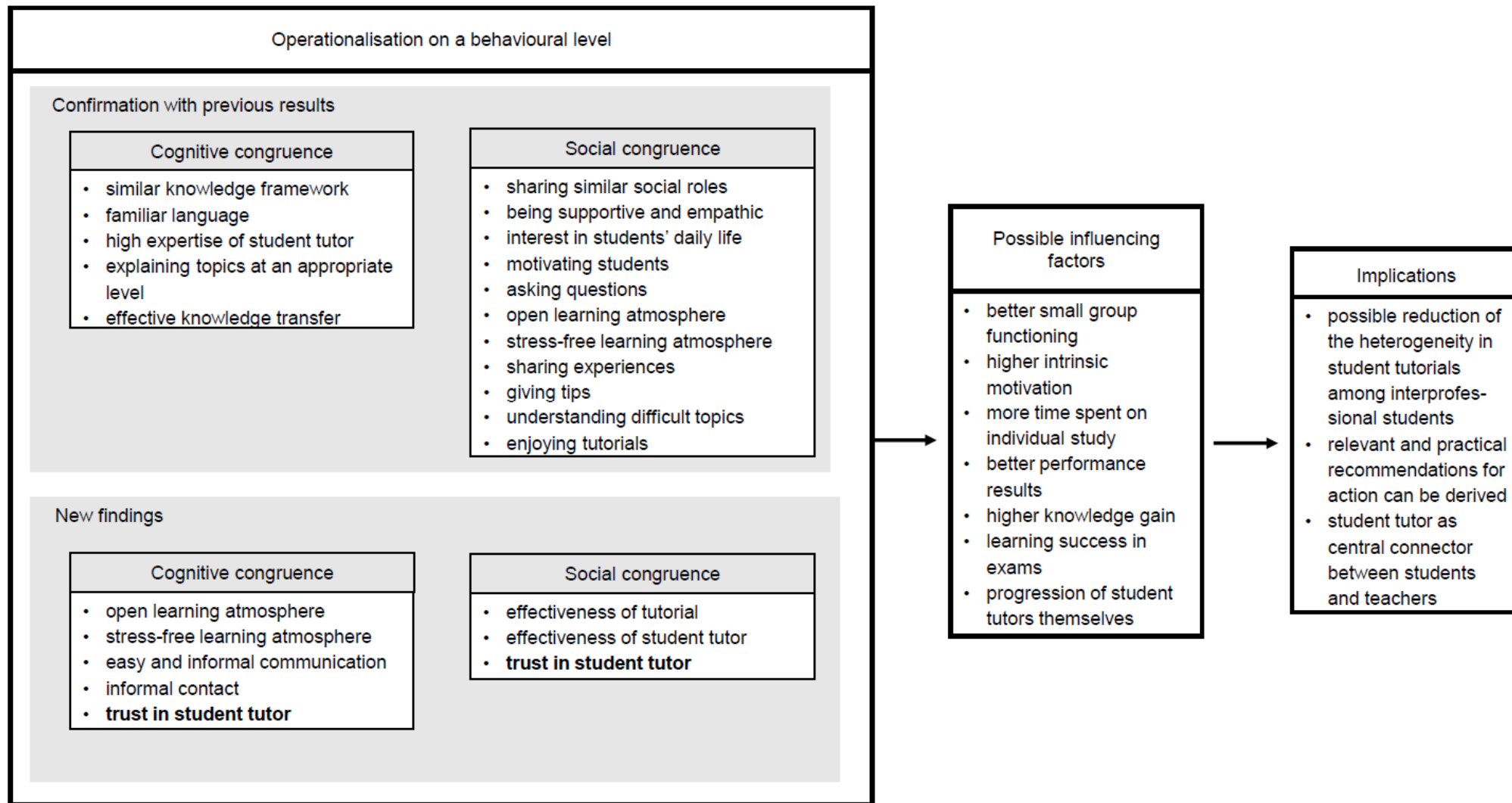


Figure 3. Findings on cognitive and social congruence and their possible influencing factors and implications.

## 4.6 Implications for Medical Training

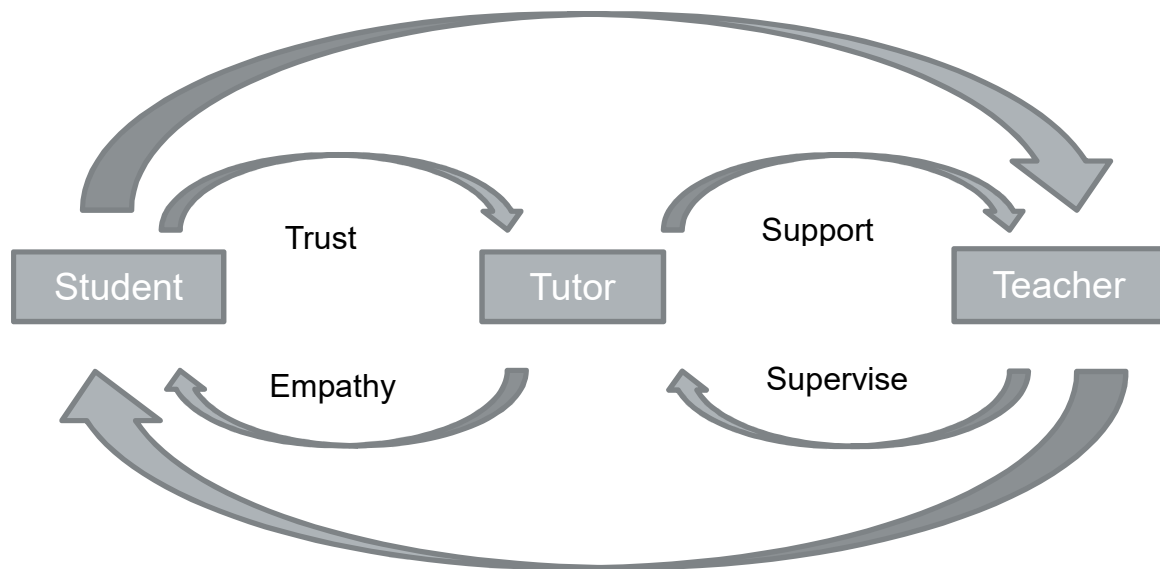
Training courses with a focus on relevant behavioural aspects of cognitive and social congruence based on this doctoral thesis could be established and applied in medical training (Loda et al., 2020a). Student tutors could specifically train how to interact with students to be cognitively and socially congruent (Loda et al., 2020a).

Implications for student-tutor training can be derived based on the results, specifically relevant and practical recommendations for action. Student tutors should continue to use a similar knowledge base and language (Loda et al., 2020a). Student tutors should be aware of the fact that students expect them to have special detailed knowledge (Loda et al., 2020b). From a professional perspective, students trust their student tutors in possessing knowledge and skills. Furthermore, students exhibited high confidence in their student tutors when reporting on private difficulties. The high trust of students in their student tutors on a professional and interpersonal level should be considered a relevant point for future student-tutor training (Loda et al., 2020b).

The trustful relationship between students and student tutors based on cognitive and social congruence also plays a key role, as student tutors might offer social and emotional support for students. Medical students might show a high stress burden due to the demands of medical training (Erschens et al., 2019). Stressed medical students can confide in their student tutors and discuss the difficulties in their medical studies. Student tutors should be prepared for this task in student-tutor training. Student tutors should also learn techniques on how to create a relaxed learning atmosphere, how to motivate students, and how to behave empathically and supportively (Loda et al., 2020b).

Moreover, the results imply that student tutors possibly serve as central connectors between students and lecturers, as student tutors are closer to students than teachers. Students are also less afraid of student tutors and admit to having difficulties when they do not understand a topic correctly. This is more difficult for students when they must admit this to a teacher. Student tutors, in turn, are empathic and supportive of the students. Furthermore, student tutors are closer to teachers

than students, as they support teachers. Simultaneously, teachers supervise student tutors and tutorials because they are responsible for them. As students and teachers have a relationship, student tutors might work as mediators who influence the relationship between them (Figure 4). Simultaneously, student tutors cannot substitute for the teachers, but they can foster learning in medical students.



**Figure 4. Student tutors as central connectors of the relationship between students and the teacher.**

The new knowledge about cognitive and social congruence can also be applied in student tutorials. In student tutorials in the medical and psychology fields, students learn how to take the medical history of real patient cases. Based on the results of cognitive and social congruence, student tutors should consist of one medical and one psychological student so that student tutors and students have similar social roles. The atmosphere in the tutorial should be open and stress-free to ensure an effective tutorial. Furthermore, communication in tutorials should take place easily and informally. In the tutorial, there should also be time and space for private or study-related problems where student tutors might help students based on the experiences of the student tutors. Moreover, there should always be the chance to have fun and enjoy the tutorial, particularly because tutorials are often voluntarily.

## **4.7 Strengths**

This doctoral thesis presents the first investigation of cognitive and social congruence in PAL to operationalise the concepts on a behavioural level of students and student tutors among German medical students by reviewing previous findings and using qualitative and quantitative analyses (Subprojects 1 to 3). The perspective of the student tutors regarding cognitive and social congruence was first assessed quantitatively (Subproject 3). As the sample size of the study participants in Subproject 3 was large (over 676 medical students, including student tutors and students) and consisted of various years of study of medical education, the results found for cognitive and social congruence are representative. The operationalisation of cognitive and social congruence was examined using factor analysis. Furthermore, the perspectives of all those involved in PAL, including the medical students as participants, student tutors as teachers, and lecturers as supervisors, were gathered to obtain a comprehensive model of cognitive and social congruence (subproject 2).

## **4.8 Limitations**

Some possible limitations must be reported. This doctoral thesis is limited to cognitive and social congruence in the PAL context. Subject-matter expertise was not considered. De Rijdt et al. (2012) suggested that expertise might play a less relevant role because the authors found that students did not miss a student tutor's expertise when it was compensated by cognitive congruence (Loda et al., 2019). In addition, only student tutors were questioned or interviewed who were more advanced than the students and were not on the same level regarding PAL. Furthermore, the generalisability of the results is limited, as the results are only representative of medical students and teachers at the Medical Faculty of Tuebingen

In Subproject 3, an adequate model fit of cognitive and social congruence was assumed, although the chi-square test was significant, and the hypothesis was accepted. The significant result of the chi-square test could be explained by the large sample size, including 527 medical students and 149 student tutors (Moosbrugger & Schermelleh-Engel, 2012). The high correlation among cognitive and social

congruence might be explained by several items that were associated with both cognitive and social congruence (e.g. a stress-free learning atmosphere).

#### **4.9 Future Research**

As there is an overlap of several items of cognitive and social congruence, such as trusting in the student tutor, future studies should investigate these concepts more closely and examine the assumptions of this doctoral thesis. Future research could also focus on the role of student tutors in the relationship between students and teachers. Moreover, the relationship between cognitive and social congruence should be considered in future research, as several studies have concluded in path models that social congruence presents an ascendant for cognitive congruence (Schmidt & Moust, 1995; J. C. Williams, 2012). Additionally, cognitive and social congruence could influence further relevant PAL outcomes, such as group performance and study motivation directly and separately (Schmidt & Moust, 1995). These results might be relevant for teaching in the interprofessional context. In future research, factors of cognitive and social congruence on a behavioural level that are identified in this research should be tested regarding the group functioning or individual learning performance of students. The teaching of student tutors should be compared to teaching non-peer students, such as post-doctoral students as tutors.

### **5. Conclusion**

This doctoral thesis aimed to investigate cognitive and social congruence on a behavioural level in the PAL context. To operationalise cognitive and social congruence, three subprojects were developed, which were systematically built on the content of the previous one. First, a scoping literature review on cognitive and social congruence was conducted to gain an overview of the previous literature and to confirm the research gap, namely the investigation of cognitive and social congruence with a focus on the behavioural aspects of student tutors. In the next step, semi-structured interviews on cognitive and social congruence were conducted where, besides students as participants, student tutors as teachers and lecturers as supervisors were interviewed about this topic for the first time. Based on the findings of the review and interviews, a novel instrument of cognitive and social congruence

was developed. The instrument was tested using exploratory and confirmatory factor analyses. Using this new instrument, cognitive and social congruence were assessed and operationalised on a behavioural level from the perspectives of the students and student tutors. Most items were associated with cognitive and social congruence directly (e.g. the same knowledge base for cognitive congruence or being interested in the student for social congruence). Several items, such as trust in the tutor or the learning atmosphere, might belong to cognitive or social congruence or both depending on the students' perspective and the tutorial context. When students trust their student tutors in their knowledge and skills, the item belongs to cognitive congruence. However, when the students trust their student tutors on an interpersonal level, it represents a relevant factor for social congruence, of which student tutors should be aware. Thus, student tutors present social and emotional support for medical students. Relevant and practical recommendations for action can be derived for student-tutor training based on the findings, in particular. For example, student tutors should meet their students at their level.

## 6. References

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## **7. Statement of Contributions**

### **Manuscript 1:**

TL and AHW were responsible for the design of the work as well as acquisition, analysis and interpretation of data. TL drafted the first version of the manuscript while AHW was involved in drafting the work. HL was involved in data acquisition, analyses and revised the manuscript critically. RE and KK were involved in the analysis and interpretation of the work and revised it critically. CN, FJ and SZ made substantial contributions to the interpretation of data of the work and revised the manuscript critically. All authors approved the final version of the manuscript and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

### **Manuscript 2:**

TL and AHW were responsible for the design and conduction the study, as well as acquisition, analysis and interpretation of data. TL drafted the first version of the manuscript. TL and RE were involved in data analyses and interpretation and RE revised the manuscript critically. SZ made substantial contributions to the study design and revised the manuscript critically. AHW revised the manuscript.

### **Manuscript 3:**

TL and AHW were responsible for the design and conduction the study, as well as acquisition, analysis and interpretation of data. TL drafted the first version of the manuscript. TL and RE were involved in data analyses and interpretation and RE revised the manuscript critically. CN, KG, FJ and SZ made substantial contributions to the study design and revised the manuscript critically. AHW revised the manuscript critically. All authors approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

## 8. Manuscripts

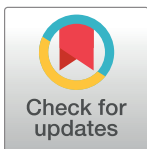
## RESEARCH ARTICLE

## Cognitive and social congruence in peer-assisted learning – A scoping review

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## Abstract

This scoping review presents an overview of cognitive and social congruence in peer assisted learning (PAL), as the positive effects of PAL have been shown to rely on these critical factors. The scoping review followed the guidelines of the preferred reporting items for systematic reviews and meta-analyses (PRISMA) statement. Databases were systematically searched for articles that focus on PAL and cognitive and social congruence. Participants of the studies included were medical, health science, polytechnic, law and paramedic students. Studies that assessed cognitive and social congruence by questionnaires with a 5-point Likert scale were regarded for meta-analytic pooling. Sixteen of 786 identified articles were included in the review, whereof 9 studies were considered for meta-analytic pooling. The meta-analytic pooling showed that tutees tend to see their student tutors as cognitively ( $M_{weighted} = 3.84$ ; range of  $M_{weighted} = 2.69$ – $4.56$ ) and socially congruent ( $M_{weighted} = 3.95$ ; range of  $M_{weighted} = 2.33$ – $4.57$ ). Further, characteristics of student tutors are summarized. This scoping review presents an overview and operationalization of cognitive and social congruence in PAL. Based on the presented meta-analytic pooling, cognitive and social congruence were found to represent relevant key factors in the PAL context. Thus, this theoretical background should be acknowledged as a core concept for tutorials within the medical curriculum.

## OPEN ACCESS

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## Introduction

Over the past decades, the concept of peer-assisted learning (PAL) has firmly established itself in the field of medical curricula [1–4]. Topping and Ehly [5] defined PAL as the “acquisition of knowledge and skills through active help and support among status equals or matched companions.” [5]. Peer-assisted learning has a long tradition in the teaching of students [6] and was used in numerous courses of study such as health sciences or law [7, 8]. Peer-assisted learning, further, plays a relevant role in the medical training [9–11] and is one of the most valuable teaching methods in the undergraduate medical education because all persons involved benefit from this learning concept [12]. So, PAL has been able to impact on the



medical curriculum by enabling new ways of teaching where, rather than a professional teacher, peers are actively involved in the teaching process. Students acting as teachers are usually called “student tutors”, while the students being taught are characterized as “tutees”. In some studies, student tutors are also described by tutees as so-called journeymen or facilitators [13–15]. An overview of relevant terminology and definitions of PAL and its associated instructors can be found in Herrmann-Werner et al. [16].

Numerous studies have confirmed high levels of satisfaction with this instructional method, and tutees, in particular, have stressed the fact that they experienced themselves as being less anxious and receiving more honest, realistic and helpful feedback in a PAL context [9, 11, 13, 17–19].

### Findings of cognitive and social congruence in PAL

Cognitive congruence in the PAL context is described as student tutors and tutees sharing the same knowledge framework [7, 9, 13, 20, 21]. Student tutors have been shown to know where students are struggling and to be able to consider topics as important, difficult or as basic knowledge [9]. Furthermore, cognitive congruence is nurtured by the fact that student tutors use language that is familiar to tutees [7, 22–24]. All these factors enable student tutors to explain difficult topics or concepts at appropriate levels for tutees’ comprehension [7, 17, 20, 21].

Social congruence in PAL is created by the fact that student tutors and tutees share similar social roles [7, 9, 25–27]. Consequently, tutees feel more comfortable with their student tutors than with their teachers [7, 9, 26, 27]. Social congruence enables student tutors to be more supportive and empathic towards tutees’ needs, difficulties, and expectations and to communicate in informal way [7, 9, 15]. Furthermore, student tutors demonstrate social congruence by being interested in tutees’ academic workloads and daily lives because they themselves have already completed the same course successfully at an earlier stage of their studies [7, 9, 15]. Several studies have postulated that social congruence might also be reflected by student tutors encouraging their tutees to actively participate in class by giving feedback, taking risks and asking questions [13, 18, 28].

### Cognitive and social congruence as key factors for effective PAL

Past studies have indicated that the effectiveness of PAL seemed to be rooted in the concepts of cognitive and social congruence [7, 9, 10, 23, 29]. Several studies postulated that cognitive and social congruence between student tutors and tutees could result in a powerful PAL experience [7, 9, 13, 20]. Huhn et al. [30] showed that cognitive and social congruence also presented key factors for success in regard to the education of international medical students.

The concept of cognitive and social congruence was first investigated by Schmidt and Moust [7] as a theoretical model of student tutor performance in an actual teaching session. Their theoretical model linked subject-matter expertise, social congruence and cognitive congruence to the functioning of small student groups, time spent on studying individually and student outcomes such as academic success [7, 31]. The theoretical model showed that higher social congruence and higher subject-matter expertise could contribute to higher cognitive congruence among student tutors [7, 32]. In turn, higher cognitive congruence might lead to better functioning of small student groups and greater performance, expressed by higher intrinsic motivation, more time spent on individual study and better examination results [7, 32]. In addition, Lockspeiser et al. [9] looked at the two concepts of cognitive and social congruence in a medical program with second-year medical students serving as near-peer student tutors for first-year students. First-year students involved in this study reported that their



student tutors were able to anticipate the problems they had when understanding new concepts in class and that they automatically shared their experiences and strategies, thereby assisting the first-year students to overcome their learning difficulties [9, 31]. Further studies about cognitive and social congruence in a peer-teaching context attempted to identify the optimal distance along a “peer-teaching spectrum” in regard to the matching of cognitive and social congruence between student tutors and tutees by comparing the assessment of tutees when taught by student tutors, staff tutors or junior doctors [11, 12, 28].

### Aim of the investigation

Despite the widely accepted fact that cognitive and social congruence might represent highly relevant concepts in the success story of PAL, these two terms have not yet been clearly defined and operationalized. Only Schmidt and Moust [7, p. 710] stated possible definitions as cognitive congruence ‘referred to a student tutor’ ability to use explanations that were easily grasped by students’ and social congruence ‘referred to a student tutor’s willingness to act informally with students and displayed a caring attitude’. This scoping review aims to, generally, define and operationalize cognitive and social congruence based on previous findings like Schmidt and Moust [7]. To the best of our knowledge, there has been no scoping review thus far of these crucial factors in PAL.

Further, since the results of previous studies are very heterogeneous, this paper purposes to present an overview of how cognitive and social congruence on the part of student tutors are perceived by tutees. When possible, data were used for an international comparison in a meta-analytic pooling. In summary, the following research questions will be addressed in this scoping review:

1. How is cognitive and social congruence, generally, defined and operationalized in peer tutoring?
2. How cognitively and socially congruent (based on self-reported instruments) were the student tutors perceived by their tutees in previous studies?
3. What further characteristics/competencies should student tutors have in order to be cognitively and socially congruent with their students?

### Materials and methods

The present study is based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [33, 34].

### Ethical considerations

The study received ethical approval from the Ethics Committee of Tuebingen Medical Faculty (No. 129/2017BO2) in April 2017.

### Protocol

No review protocol exists.

### Study search

Relevant studies were searched in an electronic general database (Google Scholar), in two databases with medical backgrounds (PubMed, PsycINFO) and two databases with educational

scientific backgrounds (ERIC, FIS). The search terms used for each electronic database included the following: "cognitive"[All Fields] OR social[All Fields] AND congruence[All Fields] OR (peer[All Fields] AND assisted[All Fields] AND ("learning"[MeSH Terms] OR "learning"[All Fields])) OR (near[All Fields] AND peer[All Fields] AND ("learning"[MeSH Terms] OR "learning"[All Fields])) OR (near[All Fields] AND peer[All Fields] AND ("education"[Subheading] OR "education"[All Fields] OR "teaching"[All Fields] OR "teaching"[MeSH Terms])) OR (peer[All Fields] AND tutoring[All Fields]) OR ("students, medical"[MeSH Terms] OR ("students"[All Fields] AND "medical"[All Fields]) OR "medical students"[All Fields] OR ("medical"[All Fields] AND "students"[All Fields])) AND ("students"[MeSH Terms] OR "students"[All Fields]). Additionally, relevant literature associated with this topic was searched for in grey literature using Open Grey. From November 2016 until February 2018, we searched for relevant studies published between 1993 and February 2018. The search was started in 1993 because Moust [35] was one of the first to mention cognitive and social congruence in peer learning.

### Study selection

For inclusion in the scoping review, studies needed to fulfil the following criteria that were oriented on the PICO (Population, Intervention, Comparison/Control and Outcome) approach [33]. Cross-references of the studies included were also checked. (1) Studies from every discipline were included due to the limited number of studies found. (2) The students must have been taught by student tutors, who had to be more academically experienced than the tutees in the taught field. (3) The extent of cognitive and social congruence was considered from the tutees' point of view through Likert-scale based instruments used in the reported studies. (4) Tutees had to evaluate the levels of cognitive and social congruence of their student tutors . . . Finally, studies that had used staff tutors, junior doctors or specialists as peer teachers were excluded from the present investigation.

### Study design

Studies with cross-sectional or longitudinal designs were included in the present study. Reviews, comments, editorials, case studies or letters to the editor were excluded. Relevant studies should to have been peer-reviewed (except grey literature) and written in either the English or the German language.

### Study outcomes

The study outcomes had to focus on cognitive and social congruence and associated factors on a behavioral level demonstrated by student tutors and assessed by their tutees.

### Screening and selection of studies

Two authors (HL and TL) independently screened titles and abstracts of publications focusing on cognitive and social congruence in line with the inclusion criteria. According to the screening process, the articles were categorized as "eligible" or "ineligible" studies. Studies found to be ineligible by both reviewers were excluded immediately. Those that at least one reviewer judged eligible were included. Cohen's kappa was calculated to test for inter-rater reliability. The studies first declared eligible were screened by full-text analysis by the reviewers (HL and TL). Finally, all articles that were declared eligible based on full-text analyses were included. Whenever the two reviewers disagreed, the corresponding article was screened by a third reviewer (JT), who then decided to include or exclude the article.

## Quality assessment of included studies

For quality assessment, the study extracted the following dimensions: study design, participants, population size, applied instruments and reported results of cognitive and social congruence. All included studies were chosen with regard to their focus on the investigation of cognitive and social congruence and corresponding primary descriptive data. Cognitive and social congruence had to be measured by questionnaires that assess cognitive and social congruence such as the self-report questionnaire adapted by Schmidt and Moust [7] or by items that have been shown to be associated with cognitive and social congruence. The questionnaire of Schmidt and Moust [7] was shown to be reliable and valid [31]. To prevent the risk of bias in studies with associated items, we checked the single items carefully by study if they were associated with cognitive and social congruence. Cognitive congruence, for example, was associated with giving helpful feedback, while social congruence might reduce anxiety in tutees [19]. Further, cognitive congruence was measured by items such as “The student tutor asked questions we could understand”. Social congruence, for example, was represented by items such as “The student tutor showed interest in our personal lives”.

## Measurement of cognitive and social congruence

Half of the included studies used the Tutor Evaluation Questionnaire developed by Schmidt and Moust [7] to measure cognitive and social congruence. The questionnaire consists of 10 items on a 5-point Likert scale (first version only consists of 3-point Likert scale) from “fully disagree” to “fully agree” or from “not true at all” to “very true”. Several studies tested the reliability and validity of the questionnaire by calculating Hancock’s coefficient ranging from 0.70 (for social congruence) to 0.77 (for cognitive congruence) [14, 18, 31, 36, 37]. The further questionnaires used to assess cognitive and social congruence also proved to be reliable and valid with Cronbach’s alpha from 0.80 to 0.87 [8, 11, 12, 38].

## Statistical preparation of meta-analytic pooling

For meta-analytic pooling, we calculated the weighted mean values of the measurement of cognitive and social congruence based on the size of the sample and the results of the studies included. Mean values were used for meta-analytic pooling because only mean values of the instruments were reported. Whenever the resulting mean values of cognitive and social congruence were not reported in the articles, we contacted the authors to ask for the raw data. When studies reported only single items concerning cognitive and social congruence or results from several classes, we calculated the overall mean values of cognitive and social congruence based on the reported values. If necessary, values were recalculated and adapted to a 5-point Likert scale. As mentioned above, only mean values of student tutors (e.g. senior medical students) are presented in this study. All calculations were made by using IBM SPSS V24.

## Results

### Search results and quality assessment

According to the PRISMA statement, the flowchart (Fig 1) presents the search results and the associated quality assessment adapted for the aim of this review. Overall, 786 records were identified by searching databases. After removing duplicates and screening titles as well as abstracts, 78 articles remained to be evaluated by full-text reading to determine their eligibility. In total, 62 articles were excluded after full-text analysis: 48 articles had no reference to cognitive and social congruence, 9 presented no statistical values, and 5 demonstrated items that

were associated with behavioral patterns in PAL but not directly with cognitive and social congruence. The inter-rater reliability was substantial, with Cohen's kappa  $\kappa = 0.767$  ( $p < .001$ ).

Finally, 16 studies were included in the review. We differentiated between investigations that assessed cognitive and social congruence directly by using questionnaires ( $n = 14$ ) and studies that measured these two constructs by associated items presented in former studies ( $n = 2$ ) (see [Table 1](#)). The participants of the included studies were medical, health science, polytechnic, law and paramedic students.

### Meta-analytic pooling

In the meta-analytic pooling, 10 of 16 studies fulfilled the inclusion criteria and were thereby included; for 5 of these 10 studies, we calculated the mean value ourselves, as only single items measuring cognitive and social congruence or results from other Likert-scale or from several classes were reported in the original versions of these studies. We considered the mean values of cognitive and social congruence assessed on a 5-point Likert scale.

Regarding all studies of the meta-analytic pooling that measured cognitive and social congruence on a 5-point Likert scale (from “fully disagree” to “fully agree”), the weighted mean value of cognitive congruence was  $M = 3.84$  (range of  $M = 2.69$ – $4.56$ ). The weighted mean value of social congruence was  $M = 3.95$  (range of  $M = 2.33$ – $4.57$ ) (see [Table 1](#)). The sample sizes of the included studies ranged from  $N = 77$  to  $N = 12,358$ . When the studies were separated into two groups, including cognitive and social congruence assessed by self-reported questionnaires or measured by associated items, the weighted mean values differed slightly in cognitive and social congruence between the two groups. The weighted mean value of cognitive congruence was lower for the studies with associated items ( $M = 3.32$ ; range of  $M = 2.69$ – $3.80$ ) when compared to the weighted mean value of cognitive congruence for the studies with valid and reliable questionnaires ( $M = 3.98$ ; range of  $M = 3.65$ – $4.56$ ). Furthermore, we found similar results for social congruence when including both groups of studies. The weighted mean value of social congruence was  $M = 3.18$  (range of  $M = 2.71$ – $3.55$ ) for studies with associated items and  $M = 3.75$  (range of  $M = 2.33$ – $4.57$ ) for studies with assessed questionnaires. Overall, the results show that tutees seem to consider their student tutors as cognitively and socially congruent, respectively (see [Fig 2](#)).

### Further significant results on cognitive and social congruence

Several studies from a working group in Southampton (UK) investigated the optimal distance along the peer-teaching spectrum in terms of students' perceived distance from their teachers on such a range. The students were asked to rate their perceived cognitive and social congruence to a senior medical student tutor vs. a junior doctor tutor, faculty tutor or consultant tutor [[11](#), [12](#), [28](#)]. Student tutors scored significantly higher when looking at criteria for social congruence (“enjoyment” and “approachability”) as well as for cognitive congruence (“relevance”, “use of time” and “delivery of teaching”) [[28](#)]. Consequently, student tutors were perceived as more cognitively and socially congruent by tutees compared to faculty or consultant tutors in a peer-learning context [[11](#), [12](#), [28](#)].

Other studies investigated cognitive and social congruence as teacher characteristics or teaching behaviors within different path models to find dependencies of different variables associated with PAL such as “tutorial group functioning”, “situational interests” or “study achievement” [[7](#), [14](#), [31](#)]. In every path model calculated, the results showed that cognitive congruence is influenced by social congruence with  $\beta$  ranging from 0.28 to 0.51 and by subject-matter expertise ( $\beta = 0.41$ – $0.58$ ). In addition to social congruence, expertise presented a relevant ascendant for cognitive congruence. When regarding further PAL factors e.g. tutorial

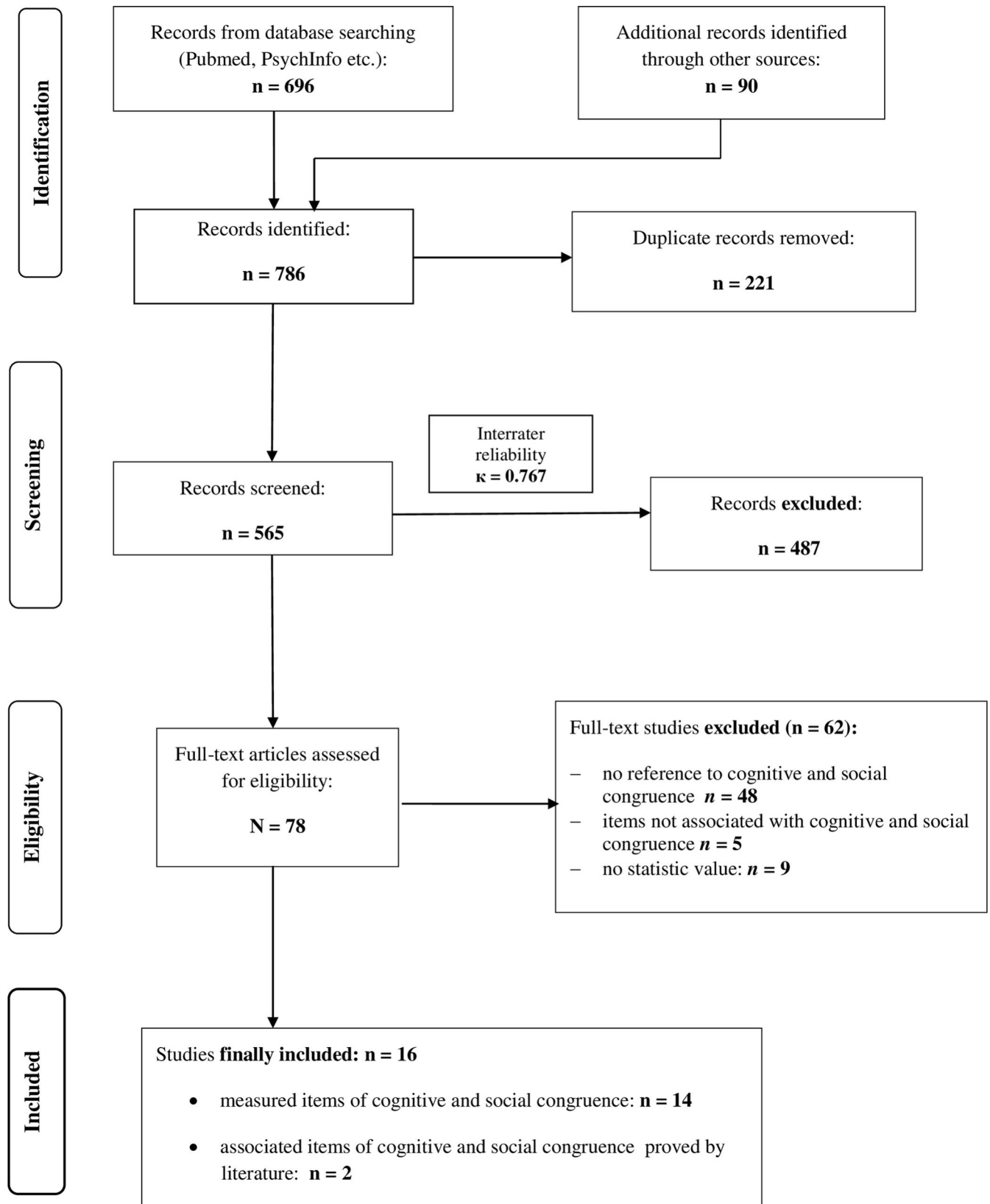


Fig 1. Flowchart of found studies.

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**Table 1. Overview of studies investigating cognitive (CC) and social congruence (SC).**

Studies of questionnaires that measure cognitive and social congruence				
Authors	Country	Instruments	Participants	Results of CC and SC
Chng et al. [36] <sup>a</sup>	Singapore	Self-report questionnaire adapted from Schmidt and Moust [7] (5-point Likert scale, 10 items)	Students: N = 223 Student tutors: N = 7	M(CC) = 3.65 (0.20) M(SC) = 3.27 (0.37)
Chng et al. [18] <sup>a</sup>	Singapore	Self-report questionnaire adapted from Schmidt and Moust [7] (5-point Likert scale, 10 items)	Students N = 77 Student tutors N = 11	Study 2: M(CC) = 3.94 (0.19) M(SC) = 3.83 (0.28)
Rotgans and Schmidt [14]	Singapore	Tutor Evaluation Survey developed by Schmidt and Moust [7] (5-point Likert scale, 10 items)	Students N = 498 Student tutors: not reported	M(CC) and M(SC) are not reported <u>secondary outcome:</u> Path models: SC bears CC with $\beta = 0.28$ ;
Schmidt and Moust [7] <sup>a</sup>	Netherlands	Tutor Evaluation Survey developed by Schmidt and Moust [7] (3-point Likert scale, 10 items)	Students: N = 1452 Student tutors: N = 261	M(CC) = 2.69 (0.447) M(SC) = 2.74 (0.371) Overall M (CC) = 4.48 <sup>b</sup> Overall M (SC) = 4.57 <sup>b</sup>
Williams [31] (Chapter 4)	Singapore	Tutor Evaluation Survey developed by Schmidt and Moust [7] (5-point Likert scale, 10 items)	Students: N = 10854 Student tutors: N = 268	M(CC) and M(SC) are not reported <u>secondary outcome:</u> Path model: SC bears CC with $\beta = 0.51$
Williams et al. [37] <sup>a</sup>	Singapore	Tutor Evaluation Survey developed by Schmidt and Moust [7] (5-point Likert scale, 10 items)	Students: N = 16047 Student tutors: N = 762	Semester 2009–1: M(CC) = 3.79 M(SC) = 3.76 Semester 2009–2: M(CC) = 3.78 M(SC) = 3.75 Semester 2010–1: M(CC) = 3.80 M(SC) = 3.77 Overall M (CC) = 3.79 <sup>b</sup> Overall M (SC) = 3.76 <sup>b</sup>
Williams [31] (Chapter 5)	Singapore	Tutor Evaluation Survey developed by Schmidt and Moust [7] (5-point Likert scale)	Students: N = 12108 Student tutors: N = 376	M(CC) and M(SC) are not reported <u>secondary outcome:</u> Student tutors with qualifications or experience are rated higher for CC
Yew and Yong [15] <sup>a</sup>	Singapore	Tutor Evaluation Survey developed by Schmidt and Moust [7] (5-point Likert scale, 10 items)	Students: N = 12358 Student tutors: N = 1065	M(CC) = 3.84 (0.25) M(SC) = 3.77 (0.35)
De Rijdt et al. [38] <sup>a</sup>	Netherlands	Online questionnaire with 12 items (5-point Likert scale) including four factors: stimulating function, cognitive congruence, social congruence and expertise	Students: N = 751 Student tutors: N = 23	Course A: M(CC) = 3.8 (1.0) M(SC) = 4.1 (0.9) Course B: M(CC) = 3.9 (1.1) M(SC) = 4.1 (1.1) Course C: M(CC) = 4.0 (0.7) M(SC) = 4.1 (0.7) Course D: M(CC) = 4.2 (0.7) M(SC) = 4.3 (0.7) Overall M(CC) = 3.96 <sup>b</sup> Overall M(SC) = 4.15 <sup>b</sup>

(Continued)

Table 1. (Continued)

Studies of questionnaires that measure cognitive and social congruence				
Authors	Country	Instruments	Participants	Results of CC and SC
Moust and Schmidt [8] <sup>a</sup>	Netherlands	Questionnaire with 39 items (5- point Likert scale) including 6 categories: use of expertise, cognitive congruence, test orientation, authority, role congruence, cooperation orientation	Students: N = 352 Student tutors: N = 11	First course: M(CC) = 3.7 (0.4) M(Role Congruence) = 3.0 (0.6) M(Authority) = 1.7 (0.6) Second course: M(CC) = 3.6 (0.5) M(Role Congruence) = 3.1 (0.6) Authority: M(Authority) = 1.5 (0.4) Overall M(CC) = 3.65 <sup>b</sup> Overall M(SC) = 2.33 <sup>b</sup> because Role Congruence and Authority can be merged into social congruence[7]
Hall et al. [10]	Southampton, UK	Formal evaluation form (4-point Likert scale) with - items relating to CC were use of time and relevance - items relating to SC were enjoyment	Students N = 60 Student tutors: N = 10	M(CC) and M(SC) are not reported (only in graphic)
Hall et al. [11]	Southampton, UK	Questionnaire (5-point Likert scale) with - items relating to CC were use of time, delivery and relevance of content - items relating to SC were enjoyment and approachability	Students N = 98 Student tutors N = 5	M(CC) and M(SC) are not reported (only in graphic) <u>secondary outcome:</u> Enjoyment as criteria of SC and use of time as well as delivery of teaching as criteria for CC scored significantly higher for senior medical students compared to junior doctors
Stephens et al. [12] <sup>a</sup>	Southampton, UK	Questionnaire (5-point Likert scale) with - items relating to CC were Use of time, delivery and relevance of content - items relating to SC were enjoyment and approachability	Students: N = 492 Student tutors: N = N. A.	CC: M (Relevance) = 4.59 M (Delivery) = 4.20 M (Use of Time) = 4.19 SC: M(Approachability) = 4.60 M(Enjoyment) = 3.96 Overall Mean CC: 4.56 <sup>b</sup> Overall Mean SC: 4.28 <sup>b</sup>
Taylor et al. [28]	Southampton, UK	Questionnaire (5-point Likert scale) with 15 items: - items relating to CC were Use of time, delivery and relevance of content - items relating to SC were enjoyment and approachability	Students: N = 240 Student tutors: N = 119	M(CC) and M(SC) are not reported (only in graphic) <u>secondary outcome:</u> Approachability of teacher, teacher's receptiveness to student input, awareness of learning outcomes and teacher's investment in examination success scored significantly higher for near-peer teachers compared to registrar or consultant tutors
Studies with single items associated with cognitive and social congruence				
Authors	Country	Instruments	Participants	Results of CC and SC
Lockspeiser et al. [9] <sup>a</sup>	San Francisco, California	Questionnaire with 14 items (5- point Likert scale)	Students: N = 111 Student tutors: N = N. A.	Mean of items that might be associated with CC = 3.8 (0.54) Mean of items that might be associated with SC = 3.55 (0.80)
Williams and Nguyen [19] <sup>a</sup>	Victoria, Australia	Clinical Teaching Preference Questionnaire CTPQ (5-point Likert-Scale, 11 items)	Students: N = 86 Student tutors: N = 25	CC: M(more honest, realistic and helpful feedback) = 2.69 (1.08) SC: M(less anxious) = 2.71 (1.02)

Weighted Mean of CC = 3.84 (range of M = 2.69–4.56)

Weighted Mean of SC = 3.95 (range of M = 2.33–4.57)

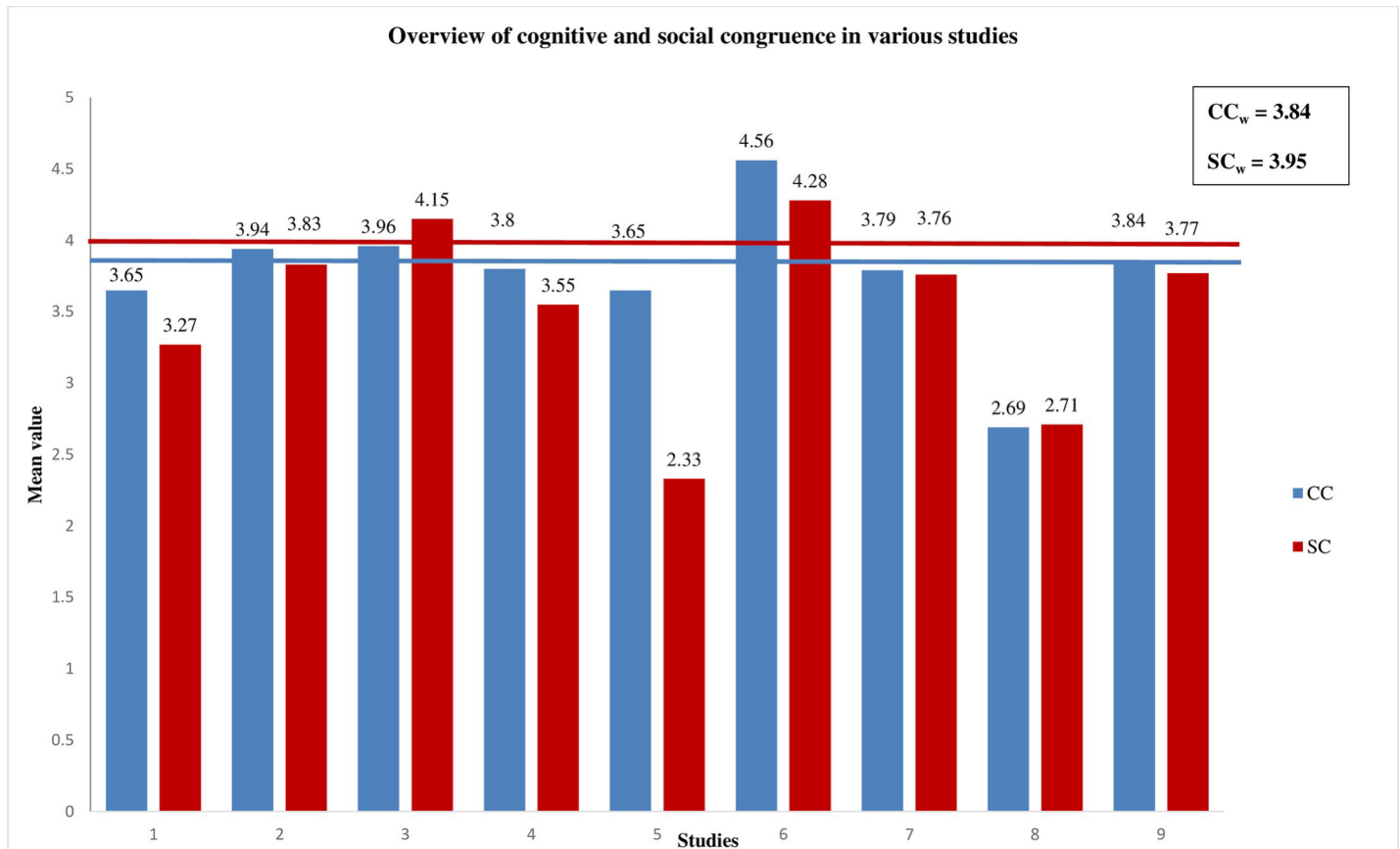
<sup>a</sup>Studies included in the meta-analytic pooling

<sup>b</sup> Mean values are self-calculated based on the results of the study (adapted to 5-point Likert scale, different semester or courses, single items)

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group functioning, Schmidt and Moust [7] demonstrated in their path model that cognitive and social congruence might also facilitate group performance in a direct causal way (CC:  $\beta = 0.18$ ; SC:  $\beta = 0.24$ ).





**Fig 2. Overview of mean value of cognitive (CC) and social congruence (SC) in various studies.**

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Williams et al. [37] conducted a study with 762 student tutors who were rated by 16,047 students focusing on the variability and variance components of cognitive and social congruence over three semesters, focusing on differences between student tutors and semesters. Here, social congruence showed the highest variance with 60.5% of difference between the student tutors followed by cognitive congruence with 56.1% variance that differed between student tutors. Only variance with 0.1% of difference was found between the semesters. These results indicate that cognitive and social congruence varies between student tutors but not between semesters.

In a further investigation, Williams [31] aimed to identify factors that might affect student tutors' behaviors including cognitive and social congruence. Using ANOVA, they demonstrated that the factors "possession of educational qualification" ( $p < .01$ ) and "year of experience" ( $p < .05$ ) had an impact on cognitive congruence. Student tutors who possessed an educational qualification or were more experienced were rated higher for cognitive congruence by students. Social congruence, however, wasn't influenced by any factor like gender or age ( $p > .05$ ).

## Discussion

This study aimed to present a scoping review of cognitive and social congruence in peer learning, including a meta-analytic pooling of previous studies on this topic. In the meta-analytic pooling, mean values of cognitive and social congruence tended to the direction of nearly



“agree”, indicating that students might perceive their student tutors as cognitively and socially congruent. We synthesized the results of previous investigations of cognitive and social congruence.

### Cognitive and social congruence as operational key factors

As the results from the reported studies showed, cognitive and social congruence could be identified as important key factors in the peer-learning context. The weighted mean value calculated for cognitive congruence could validate that tutees tend to perceive their student tutors as cognitively congruent. Further, student tutors were perceived as more honest, realistic and helpful due to greater cognitive congruence between tutee and student tutor [19]. Moreover, greater cognitive congruence might imply that student tutors could better understand the problems that tutees might experience [7, 9]. Overall, student tutors are seen as more cognitively congruent than faculty tutors [9, 38].

The weighted mean value calculated for social congruence indicated that tutees also seemed to see their student tutors as socially congruent. This result of social congruence might be interpreted best in terms of the relevance of creating an informal means of communication and relationship-building with the tutees by the student tutor [7, 20, 36]. Chng et al. [36] stressed the importance of a student tutor's willingness to establish an informal relationship with tutees and to demonstrate an attitude of genuine interest in them. Expressing interest in the tutees and their lives has been shown to have the greatest impact on the progress made by tutees in a peer-learning context [36]. Overall, tutees feel more comfortable when taught by student tutors [7, 9, 26]. The student tutors are perceived to behave more supportively and empathically towards tutees' needs, difficulties and expectations [7, 9, 15].

### Characteristics of student tutors

Several studies reported that student tutors were evaluated more cognitively and socially congruent by tutees in comparison to faculty or consultant tutors [11, 12, 28]. Therefore, student tutor should be similar in age and level of medical training like tutees but should have more expertise in the taught topic. Schmidt and Moust [7] supported this statement by showing that social congruence as teacher characteristic and expertise were a relevant ascendant for cognitive congruence.

### Discrepancies of cognitive and social congruence

Although there were apparent discrepancies between the mean values of the studies included for both concepts (ranging from 2.33 to 4.56), the relevance of cognitive and social congruence in PAL has been supported by various studies previously [11, 12, 20, 28]. The observed discrepancies in the present investigation might best be explained through studies aiming to find the optimal distance along the peer-teaching spectrum in terms of tutees' perceptions of cognitive and social congruence [11, 12, 28]. Stephens et al. [12] supported this idea by presenting significant differences between fourth- and fifth-year medical students in the feedback criteria of cognitive and social congruence when teaching second-year medical students. The results showed lower scores for feedback criteria for cognitive and social congruence for the fifth-year medical students when compared to the fourth-year medical students [12]. However, when comparing the feedback criteria results of cognitive and social congruence between third- and fourth-year medical students, no significant differences were found. Moreover, the scores of feedback criteria differed significantly when comparing the results from the fifth-year medical students with the results from junior doctors.

## Reflection of cognitive and social congruence in the literature

Despite the detailed and elaborated investigation of PAL addressed by many studies, few studies have focused on the concept of cognitive and social congruence in this learning context. Most of the previous studies investigated, in particular, the effectiveness of PAL or tutorials led by student tutors [26]. Therefore, cognitive and social congruence arise solely as presumed phenomena of effectiveness but are not regarded more closely on a behavioral level [20, 26, 39, 40].

The studies included in this review fulfilled the quality assessment for quantitative studies and assessed cognitive and social congruence through the use of valid and reliable questionnaires. Furthermore, they reported mutual dependencies of cognitive and social congruence with outcomes of the PAL context such as academic achievements of the students and student tutor effectiveness [18, 31, 36]. However, they didn't consider cognitive and social congruence more closely on a behavioral level of student tutors and tutees. Moreover, they reported their outcomes of cognitive and social congruence in very different ways; therefore, it was difficult to provide a good overview.

This study presents the first scoping review of cognitive and social congruence in peer learning. Moreover, appropriate data were included in a meta-analytic pooling, and relevant factors associated with cognitive and social congruence such as tutorial group functioning were summarized.

One limitation of the present analysis was the missing consideration and evaluation of subject-matter expertise in the scoping review of cognitive and social congruence. In many studies, expertise was investigated together with cognitive and social congruence in the peer-learning setting [7, 14, 31, 36, 37]. The present investigation, however, focused on cognitive and social congruence because expertise was assessed solely by two items within the Tutor Evaluation Survey by Schmidt and Moust [7]. Furthermore, De Rijdt et al. [38] suggested that expertise might play a less relevant role, as the authors found that students did not miss a tutor's expertise when it was compensated by cognitive congruence. Additionally, this review only focused on student tutors who were more advanced than the tutees and not on same-level PAL.

Future studies could focus on the relationship between cognitive and social congruence because several investigations resulted in the conclusion that social congruence presented an ascendant for cognitive congruence when regarding path models [7, 14, 31]. Furthermore, cognitive and social congruence influenced other PAL factors such as group performance or study motivation in a direct and separate way [7]. Hence, future studies should focus on identifying relevant factors of cognitive and social congruence on a behavioral level in order to derive specific measures and recommendations for action. Here, the teaching of student tutors should be compared to teaching of non-peer students like faculty tutors in order to receive various insights of PAL. In summary, this scoping review aims to present an overview and operationalization of cognitive and social congruence in PAL. It strengthens the relevance of the student tutor and tutee being cognitively and socially congruent for effective peer learning. Cognitive congruence implies that student tutor and tutee share a similar knowledge framework and use a familiar language [7, 9]. Social congruence is represented by the student tutor and tutee sharing similar social roles and an informal style of communication [7, 9, 20, 26, 36]. Future studies might investigate the relationship between cognitive and social congruence and associated factors like group performance or study motivation in the PAL context.

## Supporting information

### S1 PRISMA Checklist.

(DOCX)

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**Conceptualization:** Teresa Loda, Anne Herrmann-Werner.

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**Supervision:** Christoph Nikendei, Stephan Zipfel, Anne Herrmann-Werner.

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**Writing – original draft:** Teresa Loda, Anne Herrmann-Werner.

**Writing – review & editing:** Rebecca Erschens, Hannah Loenneker, Katharina E. Keifenheim, Christoph Nikendei, Florian Junne, Stephan Zipfel, Anne Herrmann-Werner.

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## Qualitative analysis of cognitive and social congruence in peer-assisted learning – The perspectives of medical students, student tutors and lecturers

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### ABSTRACT

**Background:** The teaching of students by peers, so-called peer-assisted learning, is effective based on cognitive and social congruence among students and student tutors. This study aims to investigate cognitive and social congruence by analysing the perspectives of students, student tutors and lecturers in order to receive a better understanding of these concepts and to improve the teaching in tutorials as well as the relationship among students and student tutors.

**Methods:** Cognitive and social congruence were assessed by conducting semi-structured interviews. An interview guide about teaching and relationship in tutorials was based on previous findings of Schmidt & Moust (1995) and Lockspeiser et al. (2008). The interviews were analysed inductively by using qualitative content analysis.

**Results:** Twenty-nine participants were interviewed. The following categories were found for cognitive congruence: knowledge base, high expertise by student tutors, same language and effective knowledge transfer. Social congruence was represented by relaxed learning atmosphere, sharing social roles, empathic and supportive behaviour of student tutors, sharing experiences, understanding difficulties and enjoying tutorial.

**Conclusion:** Cognitive and social congruence may be displayed on the practical behavioural level. Trust in student tutor could be found in both concepts on different levels. The qualitative results provide a deeper insight by indicating that the student tutors may play a 'mediator' role for the relationship between students and lectures.

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Cognitive congruence; social congruence; peer-assisted learning; medical students; student tutors; lecturers

## Introduction

Cognitive and social congruence are seen as key factors for an efficient peer-assisted learning (PAL) experience among students and student tutors [1–5]. PAL is defined as a well-established kind of teaching where students are taught by peers, so-called student tutors, who are mostly in higher years of study.

According to previous studies [1,5], cognitive congruence can be seen as a common and similar knowledge base between the student tutors and students. Further, using a familiar language contributes to cognitive congruence between the students and student tutors, as the student tutors explain difficult topics at an appropriate level [1,6,7]. Social congruence refers to the interpersonal level, as student tutors are interested in students' problems and demands [8,9]. Furthermore, social congruence refers to the fact that students and student tutors share similar social roles [1,5]. Social congruence is also represented by high enjoyment and approachability [10,11].

The learning atmosphere is experienced as relaxed and pleasant by the students as well as student tutors

when they are perceived as cognitively and socially congruent [12–14]. According to previous studies, students see their student tutors as cognitively and socially congruent when they share learning experiences or propose alternative solutions [1,5,15]. In turn, when tutors are perceived as cognitively and socially congruent students feel less anxious and dare to tell if they did not understand the topic [16–18].

Although PAL represents a valuable teaching tool in the general curricula, past studies postulated that it nevertheless remains under-researched [19–21]. The concept of cognitive and social congruence can be seen as a 'black box' in the PAL context. Many studies reported that PAL is effective due to cognitive and social congruence [22–25]. However, there is no empirical evidence regarding how cognitive and social congruence contribute to an effective PAL learning experience [24].

This study aims to investigate cognitive and social congruence with a focus on the student tutors' and students' relationship as well as the teaching in



tutorials by conducting semi-structured interviews for thematic analysing. The perspectives of students as participants, of student tutors as teachers, and of lecturers as supervisors were considered to receive all perceptions of cognitive and social congruence in tutorials. To the best of our knowledge, this study presents the first investigation of cognitive and social congruence that contains the perspectives of all relevant persons involved in PAL (students, student tutors and lecturers).

## Methods

### Ethics

The study received ethical approval from the Ethics Committee of Tuebingen Medical Faculty (No. 129/2017BO2) in April 2017. All participants provided their written informed consent. As incentives for participation, books and vouchers were raffled among the participants.

### Design, participants and procedure

This study presents a cross-sectional method design with semi-structured interviews on cognitive and social congruence in student tutorials. Medical students, student tutors and lecturers from the Medical Faculty of Tuebingen were invited to participate. The medical students were from different years of study, ranging from the first until the final (for details, see Table 1). Student tutors came from various fields, such as medical history, anatomy, internal medicine, physiology, skills lab, and surgery. Medical students and tutors were recruited from different classes within their usual mandatory courses. All tutors were supposed to teach the course at least one time and had a didactic qualification. Lecturers were invited online. We were interested in the perspectives of all participants in student tutorials. Table 1 presents an overview of the participants. There no significant differences in age for students and tutors.

### Measurement

Demographic information such as gender, age, year of study and questions belonging to tutorials (e.g. subject of tutorial) were included in the interviews. The student tutors, additionally, were asked about

their qualifications, their class rank and discipline as student tutors. Further, lecturers were also interviewed about demographic data such as age, gender, job, discipline and teaching experience.

### Interview guide

A semi-structured interview guide was constructed for students, student tutors and lecturers based on previous evidence [1,9,26,27]. The interview guide was created by using the SPSS-method (*Sammeln* [collect], *Prüfen* [check], *Sortieren* [sort], *Subsumieren* [subsume]) developed by Helfferich [28]. First, questions were gathered by brainstorming. Second, they were checked for coverage of the topic. Third, questions were sorted by topic, and last, they were subsumed after Helfferich [28], meaning they were ranked and subordinated. The SPSS-method was used to structure our questions based on cognitive and social congruence and develop an interview guideline. For an overview of the interview guideline please see appendix.

The interviews started with open-ended questions, followed by more targeted ones. Students and tutors answered the same questions, only from their respective perspectives. In order to investigate cognitive and social congruence with deeper insight on a behavioural level, they received questions about the teaching in student tutorials, the relation between students and student tutors in the tutorial, and general questions about the tutorial. Regarding the teaching, students and student tutors were asked about knowledge base, knowledge transfer, terminology, explanation of difficult topics and their experience. For the relationship between students and tutors, the questions were about communication, similarity, the student tutors' interest in the students, their role model function, emotions and behaviour during lesson, and their motivation. General questions dealt with the learning environment in class, learning success, effectiveness and enjoyment of the tutorial. The lecturers had fewer but the same questions about knowledge transfer, students' and tutors' communication and similarities, learning environment, and effectiveness of the tutorial.

### Data processing

All data were pseudonymised. The interviews were recorded and transcribed verbatim. Recordings and transcripts were stored on a secure computer of the University Hospital with no connection to patient or Internet network.

### Data analysis

The interviews were analysed by using the qualitative content analysis by Mayring (2015). The aim of the

**Table 1.** Demographics of medical students, student tutors and lecturers.

	Students	Tutors	Lecturers
<b>N</b>	<b>13</b>	<b>10</b>	<b>6</b>
<b>Gender</b>	<b>m = 30.8%</b> <b>f = 69.2%</b>	<b>m = 10.0%</b> <b>f = 90.0%</b>	<b>m = 66.7%</b> <b>f = 33.3%</b>
<b>Age</b>	<b>M = 23.8</b> <b>SD = 2.7</b>	<b>M = 23.5</b> <b>SD = 2.2</b>	<b>M = 41.7</b> <b>SD = 9.5</b>



analysis was to determine how the concept of cognitive and social congruence is represented in the student tutorials and reflected by the behaviour of students as participants and student tutors as teachers. The interviews were analysed inductively and iteratively by two independent raters (HL, TL), according to Mayring's qualitative content analysis [29]. The raters followed the seven-step model of Mayring [29], including paraphrasing, reduction, summing up for general paraphrases, naming and describing of categories, adding examples, building hierarchy of categories, and recoding: At the beginning, the different analysis units get determined and the important text passages are paraphrased afterwards. Then, the desired level of abstraction gets determined and the paraphrases are generalised in regard of this level of abstraction. After that, the paraphrases are reduced by selecting the most important ones and by deleting paraphrases with the same meaning. In the next step, the paraphrases are reduced even further by bundling, constructing and integrating them at the desired level of abstraction. The new statements are compiled as a system of categories. In the last step, the summarised system of categories is reviewed by orientating on the source material.

The goal of the analysis and the theoretical background were defined according to the interview guide of the semi-structured interviews. Cognitive and social congruence were chosen as main category. Cognitive congruence referred to the knowledge transfer among student tutors and students. Social congruence referred to the relationship between student tutors and students. In a second step, each of the raters started working through the material line by line and coded it by using MAXQDA Version 12.3.2. In order to obtain the same level of abstraction in building the categories, the raters revised them together and agreed on the final categories by paraphrasing representative examples and building a hierarchy of categories. Following this, both raters independently worked through the material again.

Audit trails were used to enhance trustworthiness and credibility of data analysis.

## Results

### Samples

N = 13 medical students, N = 10 student tutors and N = 6 lecturers were interviewed. The student tutors taught in average 2.85 years (SD = 1.34). The disciplines of the student tutors were anatomy, internal medicine, taking history, physiology and emergency medicine. The lecturers taught in average 7.1 years (SD = 5.1) and worked in the field of paediatrics, internal medicine, anatomy and surgery.

## Interviews

### Results of cognitive congruence

According to the analysis cognitive congruence was represented by the following categories: knowledge base, high expertise by student tutors, same language, effective knowledge transfer, and trust in student tutors. When suitable/possible, subcategories were rated from the answers of the participants for each category. Please see Figure 1 for an overview of the categories found for cognitive congruence.

### Knowledge base

Knowledge base presents one relevant point in regard to cognitive congruence. Student tutors and students should have a common knowledge base, although the student tutors have advanced knowledge.

*'At the beginning, the tutor had a higher level of education than us, but he tried to teach it to us. Of course, it was higher at the beginning, but it gradually became similar through the course of the tutorial.'* (Student 2)

*'Comparing students and tutors, the difference is normally not that large, but tutors often have a special detailed knowledge.'* (Lecturer 5)

### High expertise by student tutor

Further, student tutors are expected to have more expertise, both technically and didactically. At the professional level, they are also seen as role models.

*'Student tutors take classes before they become student tutors. This is where they learn what they have to tell the students. If there are any remaining questions, you can always ask the lecturer. And I think that they are well-prepared within this training course.'* (Student 8)

*'You don't necessarily learn how to communicate in your studies. Nevertheless, tutors get better through the training, they are advanced in their studies.'* (Lecturer 6)

*'Firstly, I found it impressive and exemplary that tutors are well-structured and know that much. I also see them as a role model, as they take so much time and really get involved, even though they have to learn a lot for their intermediate examination for medical students.'* (Student 9)

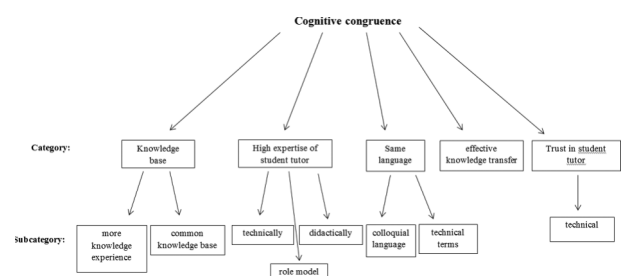


Figure 1. Categories and subcategories found for cognitive congruence based on qualitative analysis.

### Same language

In the tutorial, tutors and students should share the same language. Many reported that technical terms as well as colloquial language are used.

*‘He [student tutor] used a simple language and no specialist language as a lecturer would use. In the chemistry tutorial, we called a cancer cell “Mr. Crabs” - which a lecturer would never do. With funny memory hints.’ (Student 3)*

*‘It is most important to watch your choice of words. When you start using too many specialist terms, you often get the problem that younger students don’t know them so far.’ (Student tutor 9)*

### Effective knowledge transfer

All three groups strengthen the effective knowledge transfer in the tutorial. Students receive a higher knowledge gain and tutors have progressed as students themselves in their curriculum.

*‘The information content of the tutorial was really good. I’m more of a practical person anyway. When I see something and work it out for myself, it’s easier for me to understand.’ (Student 10)*

*‘They all [students] find it [the tutorial] very good, as they obtain a lot of knowledge in the tutorial and are able to a lot more things afterwards.’ (Student tutor 5)*

*‘I think it [the tutorial] is definitely very efficient, as the students are closely accompanied [by the student tutors], much more than it would be possible with a medical colleague.’ (Lecturer 4).*

### Trust in student tutors

When trust in tutors is particularly technical, this might also represent a key factor for cognitive congruence.

*I would definitely trust her [student tutor] for the content and technical knowledge. I also trust that when she says she doesn’t know it exactly and looks it up again. So I trust that she can estimate her professional competence of what she does know and is able to teach us, and what she does not.’ (Student 2)*

### Results of social congruence

Based on the evaluation of the interviews, the following categories of social congruence could be identified: trust in student tutors, relaxed learning atmosphere, asking questions directly, motivation, sharing social roles, empathic and supportive behaviour of the student tutors, sharing experiences and giving tips, understanding difficult topics, and enjoying the tutorial (see also Figure 2).

### Trust in student tutors

In regard to social congruence, trust in student tutors was seen on an interpersonal level where students

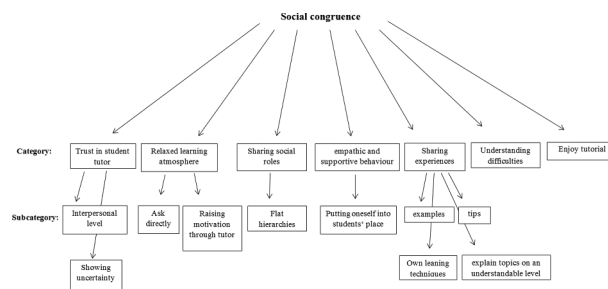


Figure 2. Categories and subcategories found for social congruence based on qualitative analysis.

could show their uncertainty and contact tutors about problems.

*‘Here, again, it mostly applies to the younger students who recently moved away from home. Tutors like to ask.’ (Student 1)*

*‘... you can do things outside the tutorial, meaning not only professionally but also on a friendship basis.’ (Student tutor 1)*

*‘... it’s inevitable that they also ask about living situation, cooking recipes or whatever.’ (Lecturer 1)*

### Relaxed learning atmosphere

A relaxed learning atmosphere was shown as a relevant point for social congruence.

*‘... the learning atmosphere is casual, but concentrated. It leaves room for entertaining moments. I think that’s really important for learning ... You should be allowed to laugh, but you also need to convey what has to be achieved and which means you have for that.’ (Student 2)*

*Motivated, concentrated, and relaxed. Such delightful learning.’ (Student tutor 2)*

*‘Content should be conveyed with pleasure and fun. Especially, one [tutor] should pay attention to important details that need to be passed on to the students.’ (Lecturer 2)*

### Asking questions directly

Students should be allowed to ask questions directly.

*‘The interaction is more personal, and questions are asked more directly than if you would ask a lecturer.’ (Student 2)*

*‘Everybody likes to ask, and one dares to ask questions.’ (Student tutor 3)*

### Motivation

Further, the student tutors could raise the students’ motivation for the tutorial.

*‘If you had a bad day, it could lift you up and motivate you.’ (Student 1)*

*‘If the tutor was good, the motivation was always higher.’ (Student 3)*

### Sharing similar roles

All three groups reported that student tutors and students share similar roles, and in this context, the relevance of flat hierarchies.

*'... most of the time, these were people I could identify with more. These were people who rather like to have contact with others ... That's why I shared more with them than with others.'* (Student 4)

*'[We have the] same job later, same student surroundings, same learning environment, problems and challenges.'* (Student tutor 4)

*'A big advantage of our tutorial is that tutors and students are very close.'* (Lecturer 2)

### Empathic and supportive behaviour of student tutor

Moreover, student tutors show empathic and supportive behaviour towards the students. They are able to put themselves into the students' place.

*'For lecturers, it has been a long time since they learned it. So they are not able to put themselves in the students' place so easily. That's why they formulate some things in a too-complicated or too-easy way. They cannot judge our knowledge level correctly. The student tutor is better at this.'* (Student 6)

*'I show it once, and then they can practice themselves. I support them, explain something or answer questions.'* (Student tutor 5)

*'They are empathetic and supportive. We request our tutors to walk around the rows and ask if there are problems or if there is a need for help.'* (Lecturer 5)

### Sharing experiences and giving tips

In regard to social congruence, tutors share their experiences with the students by giving examples or tips. They also present their own learning techniques and explain topics on an understandable level.

*'They give us advice based on their experience or what they felt to be important.'* (Student 6)

*'I do share my experiences. Or what I also do is when I have friends from AGN [Working Group Emergency] who sometimes have been part of the rescue service for several years and have some practical advice that is not in the book, I invite them'* (Tutor 6)

### Understanding difficult topics

Based on our findings, social congruence supports student tutors to understand the students' difficulties with a topic as they are also students and thus, they mostly know the students' difficulties.

*'He could understand them well. I also told him when I had difficulties.'* (Student 3)

*'We are better at understanding what difficulties might be. I was able to relate to the problems. At the*

*beginning, when I became a tutor, this was also my problem to understand it well.'* (Student tutor 7)

*'Indeed, you also think that tutors are closer to students' problems or they are better at relating to them.'* (Lecturer 1)

### Enjoying the tutorial

Finally, the tutorial should be fun so students and tutors might enjoy them.

*'When you really learned something and didn't have the feeling of wasting your time.'* (Student 9)

*'I just really enjoy it because they all participate with such enthusiasm.'* (Student tutor 8)

*'Student tutors giving us feedback say they have fun. Most of the time, they have already been student tutors in the dissection course before, and they enjoyed it, and then they also want to do a course in the clinical part.'* (Lecturer 1)

### Discussion

This study aimed to assess cognitive and social congruence with a focus on the behavioural level of students and student tutors by conducting interviews with all relevant persons involved, including students, student tutors and lecturers. Cognitive congruence was represented by the following categories: knowledge base, high expertise by student tutors, same language, effective knowledge transfer and trust in student tutors. For social congruence, we found trust in student tutors, relaxed learning atmosphere, asking questions directly, motivation, sharing social roles, empathic and supportive behaviour of the student tutors, sharing experiences and giving tips, understanding difficult topics, and enjoying the tutorial as associated categories

As many studies have already reported, cognitive congruence has been based on the same knowledge framework and similar language between the students and student tutors [1,2,5,25,27]. The results of this study further showed that the student tutors had an advanced knowledge that focuses on relevant details for the students' learning [30]. Student tutors were expected to have more expertise, both technically and didactically, which might contribute to cognitive congruence between student tutors and students. Especially when regarding the professional level, they were seen as role models by the taught students. Schmidt [1] shows that expertise next to social congruence was a strong predictor for cognitive congruence. Other studies even postulated that students did not miss the expertise of the student tutors, as it was compensated by cognitive congruence [5,31,32]. Besides, all three groups including students, student tutors and lecturers strengthened the effective knowledge transfer in the tutorial. This knowledge transfer

might be associated with cognitive congruence, as the students were closely accompanied by the student tutors when practicing in the tutorial. Many studies reported that PAL is effective due to cognitive congruence [5,19,33,34]. Consequently, the present study assumes that the effective knowledge transfer that contributed to cognitive congruence might be one relevant factor for effective learning success in PAL. Regarding cognitive congruence, students reported that they trust their student tutors on the content and professional level. They had trust in their knowledge and skills and feel comfortable when the student tutors do not know something and looked at it for the next class.

Trust in tutors was reported as a key element for social congruence. In this context, trust in student tutors was regarded on an interpersonal level, where students could show their uncertainty and contact student tutors regarding private problems they had. Previous studies also show this kind of interpersonal trust is built by establishing social congruence [35,36]. In contrast to previous studies, a relaxed learning atmosphere was reported as a relevant point for social congruence and not for cognitive congruence [13,14]. De Menezes (2016) argued that cognitive congruence promotes a less-stressful learning environment because students are taught at an appropriate level of difficulty and feel less intimidated [13]. Hence, in this study, a relaxed learning atmosphere was associated with entertaining moments. Even one lecturer said that the tutorial should be conveyed with pleasure and fun (Lecturer 2). As expected, student tutors were perceived as socially congruent when students felt free to ask questions directly [16,37,38]. Further, student tutors could increase the students' motivation by showing social congruence, which was also reported by Khaw [39]. All three groups reported that student and student tutors shared similar social roles, as they were able to identify with each other, which might have an impact on social congruence [1,25,27]. In accordance with previous study, student tutors were perceived as socially congruent when they behaved empathically and supportively [1,5,9]. Thus, they are able to put themselves into the students' place. These results, further, imply that students might be less afraid in student tutorials as they dare to ask questions or to admit that they did not understand a difficult topic [5]. When showing social congruence, student tutors also shared their experiences with the students by giving tips or presenting their own learning techniques. Student tutors might also understand the difficulties of students due to social congruence [1,5,9]. Finally, social congruence contributed to the fact that students as well as student tutors had fun and enjoyed the tutorial.

### ***Role of student tutors in medical training***

Student tutorial presents a relevant key element in medical training [25,26,40]. Here, knowledge is effectively imparted to the students by student tutors [41,42]. Tutorials, however, are not only effective due to the knowledge transfer. The social role of the tutors is also relevant, as student tutors deal with students as individuals during the knowledge transfer [24,37,43]. Therefore, empathy and individual support are relevant factors with regard to efficiency [9,16,17]. However, this study showed that these factors might be underestimated by students and tutors, because they perceived them unconsciously. The lecturers were more aware of these factors and should transfer them to the student tutors during the training in order to foster cognitive and social congruence. The results of this study further showed that the student tutors were much closer to the students so the students were less afraid of the student tutors as teachers [44]. This raises the question of whether student tutors act as mediator between the students and lecturers.

From a learning theory point of view student tutors might contribute to an higher knowledge gain but it highly depends on students' motivation and self-confidence [33]. Student tutors could enhance the students' motivation and support them in their learning. Though, students themselves are responsible for their knowledge gain.

### ***Implications for student tutor training***

Based on the presented results, relevant and practical recommendations for action can be derived for future student tutor training. Student tutors should continue to have the same knowledge base and language. However, student tutors should be aware of the fact that students expect them to have special detail knowledge, and they have high confidence in their knowledge and skills from a professional perspective. On the other side, students trusted their student tutors when having private difficulties. The high trust of students in their student tutors on a professional and interpersonal level should also be focused on in the training of student tutors. Further, student tutors should learn how to create a relaxed learning atmosphere and to behave empathically and supportively. They were allowed to give advice and share their learning experience with the students. Sharing social roles with students should be a relevant part of the training, as students and student tutors should be on par with each other. Finally, one important point should be that all participants should have fun and enjoy the tutorial.



### Limitations

Generalization of the results is limited, as this study was only representative of the medical students and lectures of the Medical Faculty of Tuebingen. Future studies should conduct semi-structured interviews based on the reported interview guide at other locations. The results are also limited by restricting the content to cognitive and social congruence and not regarding tutorials in general. We focused on cognitive and social congruence in order to enhance the effectiveness like knowledge transfer in tutorials and the relationship between students and student tutors. Further interesting topics like having trust in tutors were found during the analysis. These results should be investigated more closely in future PAL research. Here, future studies could also focus on the role of student tutors as they might influence the relationship between students and lectures. Moreover, there might be gender differences in the results as more students and tutors were female while lecturers were mostly male. This could impact on interactive behaviour in tutorials and should be investigated in further studies.

### Conclusion

This study assessed cognitive and social congruence on the behavioural level with a focus on students', student tutors' and lecturers' perspectives. Cognitive congruence was represented by the same knowledge base and familiar language as well as an efficient knowledge transfer with detailed knowledge of the student tutors. Social congruence was shown by a relaxed learning atmosphere, an enjoyable tutorial, empathic and supportive behaviour of the student tutors, and sharing learning experiences. Further, student tutors were perceived as socially congruent, as they share similar roles and understand the students' difficulties. Trust in students played an important role in cognitive as well as in social congruence, dependent on the professional or interpersonal level.

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### Data availability

Data are available from the corresponding editor upon reasonable request.






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## Appendix

### Interview guiding questionnaire measuring cognitive and social congruency

#### Interview guiding questionnaire (student’s version)

##### Questions concerning cognitive congruence

- (1) How did your tutor design the tutorial?
  - (1.1) Overall, how were the tutor’s lessons compared to the docent’s lessons?
  - (1.2) How effectively did the tutor use the tutorial itself to convey knowledge?
  - (1.3) What kind of language/terminology did you and your tutor use?
  - (1.4) How would you rate the expertise of your tutor?
- (2) Which ways of communication did your tutor use in the tutorial?
  - (2.1) How did your tutor explain/teach you difficult topics?
  - (2.2) To what extent was your tutor capable of understanding students’ problems?
- (3) Which topics did you feel were particularly difficult and challenging?

Questions concerning social congruence:

- (1) How was your relationship to the other students?
  - (1.1) What do you and your tutor have in common?
  - (1.2) How interested do you think the tutor is in his/her students?
- (2) I have already asked you about the ways of communication and to what extent your tutor gave you helpful advice or alternative solutions. Now I would like to know what the communication/interaction between you and your tutor was like on an emotional level.
  - (2.1) Describe your behavior and emotions during the lessons: How did you feel during the lessons?
- (3) How would you evaluate your tutor? Describe the tutor's behavior and emotions towards you as students during the lessons.
  - (3.1) To what extent did your tutor seem sympathetic and supportive towards the students?
  - (3.2) How did your tutor express praise and criticism?
- (4) All over, how motivated were you regarding the tutorials?

(4.1) Did your tutor affect your motivation

(5) Did you enjoy the tutorials?

Interview guide (lecturers' version)

Questions about teaching the tutorial and about the relationship between tutor and students


- (1) How would you describe the communication between the students and the tutor?
  - (1.1) How well did tutors and students get along?
  - (2) What do you think students and tutors have in common?
    - (2.1) Regarding the knowledge base?
    - (2.2) Regarding language/terminology?
    - (2.3) On an interpersonal level?
- (3) How would you describe the learning atmosphere in tutorials?
- (4) How would you describe the effectiveness atmosphere in tutorials?
- (5) How would you describe your interaction with the tutors?

RESEARCH ARTICLE

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# A novel instrument of cognitive and social congruence within peer-assisted learning in medical training: construction of a questionnaire by factor analyses

Teresa Loda<sup>1\*</sup> , Rebecca Erschens<sup>1</sup>, Christoph Nikendei<sup>2</sup>, Katrin Giel<sup>1</sup>, Florian Junne<sup>1</sup>, Stephan Zipfel<sup>1,3</sup> and Anne Herrmann-Werner<sup>1</sup>

## Abstract

**Background:** Peer-assisted learning is effective due to cognitive and social congruence. Cognitive congruence is created by sharing a similar knowledge base between students and student tutors. Social congruence is defined as having similar social roles. A questionnaire of these concepts was newly constructed, and this study explored the factor analysis of the instrument.

**Methods:** In a cross-sectional method design cognitive and social congruence were operationalised by exploratory and confirmatory factor analyses. Cognitive and social congruence were assessed by validated questionnaires and through self-developed items that were collected through semi-structured interviews. The questionnaire consisted of 26 items that were rated on a five-point Likert scale, from 0 = I strongly disagree to 4 = I strongly agree.

**Results:** 676 medical students participated in the study. Exploratory factor analysis for students resulted in a two-factor solution with cognitive and social congruence as confirming factors. New findings showed that the items “non-judgmental learning atmosphere” and “informal communication” were associated to cognitive congruence, “effectiveness” and “comprehensible explanations” belonged to social congruence. Confirmatory factor analysis for student tutors confirmed the resulting two-factor solution.

**Conclusions:** As one of the largest investigation of cognitive and social congruence, this study investigated the underlying mechanisms of effective PAL using factor analysis. Cognitive congruence was created by sharing the same knowledge. Knowledge transfer might play a relevant role in cognitive congruence. Social congruence focused on the relationship between student tutors and students, which might impact the content level. Practical recommended actions (using the same language) could be implemented.

**Keywords:** Cognitive and social congruence, Factor analysis, Medical education, Peer-assisted learning

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## Background

The concept of peer-assisted learning (PAL) presents a well-established methodological ingredient in the medical curriculum [1–3]. PAL is based on the idea that peers mostly in their upper years of study in medical school teach students. Past studies determined that PAL is effective especially because of cognitive and social congruence between student tutors and students [2, 4–7].

Cognitive congruence is created by a common and similar knowledge base between student tutors and students [6, 7]. As a result, the student tutor may explain difficult topics at a level students can comprehend using a familiar language [7–9]. Social congruence, on the other hand, is defined as the student tutor and their students sharing similar social roles such as being medical students [6, 7]. Student tutors show social congruence by being interested in the students' problems and demands [10, 11]. Moreover, students are motivated by the fact that their student tutors have successfully completed the course and passed the associated exam [6].

Cognitive and social congruence between students and student tutors fosters a relaxed and pleasant learning environment and may result in a powerful peer-assisted learning experience [1, 3, 6, 7, 12, 13]. Student tutors perceived as cognitively and socially congruent by students are considered empathic and supportive by sharing learning experiences and giving alternative proposed solutions [6, 7, 14]. Students, in turn, are encouraged by socially and cognitively congruent student tutors to actively participate in class, ask questions and give feedback [3, 15, 16]. Finally, cognitive and social congruence may also contribute to increasing students' motivation to study [17].

Despite the increasing relevance of cognitive and social congruence in peer learning addressed by many studies, these two concepts are not often studied. Previous studies investigated the effectiveness of peer teaching or tutorials led by student tutors and consequently assumed that cognitive and social congruence might be the reason for an efficient class [18–21]. Hence, cognitive and social congruence might be seen as kind of a "black box", as there is no practical evidence of both constructs at a behavioural level [18]. Vygotsky postulated that humans generate knowledge and meaning from the interaction between experiences and ideas and therefore construct their own knowledge which might represent cognitive congruence [22]. Further, there is no empirical evidence of how student tutors and students could become socially and cognitively congruent.

In the literature, we found several studies that assessed cognitive and social congruence [2, 7, 23]. Schmidt & Moust [7] developed items to assess cognitive and social congruence as well as expertise. This questionnaire was found to be valid and reliable [24]. However, literature showed that there are various ways to measure cognitive

and social congruence [2, 6, 11, 16, 25–27]. In this context, the practical and behavioural part of cognitive and social congruence were neglected [18]. The questionnaire of Vaughan & Macfarlane [27], e.g., did not explicitly assess cognitive and social congruence, but the behaviour of student tutors and students that might reflect both concepts. Prior findings were used to develop a questionnaire that should assess cognitive and social congruence in their full dimension with focus on behavioural aspects of student tutors and students that strengthen cognitive and social congruence.

## Methods

### Aim

This study aimed to operationalise cognitive and social congruence, on a behavioural level of student tutors and students by using a newly developed questionnaire. The perspectives of students as participants in tutorials and of student tutors were measured to comprehensively cover the full dimension (students' and student tutors' perceptions) of cognitive and social congruence in tutorials, including behaviour. The constructed questionnaire of cognitive and social congruence was tested by exploratory and confirmatory factor analysis separated for student and student tutors.

### Ethics

The study received ethical approval from the Ethics Committee of Tuebingen Medical Faculty (No. 129/2017BO2) in April 2017. The participation was on voluntary base and all medical students and student tutors provided their written informed consent.

### Design, participants and procedure

This study presents the first operationalisation of cognitive and social congruence with focus on the behavioural level of students and student tutors in a cross-sectional design with a quantitative questionnaire survey. Medical students and student tutors from the Medical Faculty of Tuebingen were invited to participate. The medical students were from different years of study, ranging from first until the final year of study (for details, see results). Student tutors came from various fields such as medical history, anatomy, internal medicine, physiology, skills lab, and surgery. They were recruited from different classes within their usual mandatory courses. As reimbursement, books and vouchers were raffled among the participants.

### Measurements

Demographic information such as gender, age, year of study, and questions belonging to tutorials (e.g. subject of the tutorial) were included in the questionnaire. Additionally, student tutors were asked about their qualifications, their number of lessons which they have already

taught and their discipline as student tutors in both measurements.

### Description of the survey

The survey was based on the instruments used by Schmidt & Moust [7] and Vaughan & Macfarlane [27]. All items of both questionnaires were translated into German. Seven further items were developed based on previous literature review (see also [6, 11, 28]) and semi-structured interviews on cognitive and social congruence that were conducted and analysed (Loda, T, Erschens, R, Nikendei C, Zipfel S, Herrmann-Werner A: Qualitative analysis of cognitive and social congruence in peer-assisted learning – the perspectives of medical students, student tutors and lecturers, submitted).

### Final survey instrument

The final questionnaire, hence, consisted of 26 items. Eight of 26 items were meant to be associated with cognitive congruence, and 15 of 26 items were expected to belong to social congruence. Two items assessed the student tutors' expertise, and one item evaluated the tutorials in general. The questionnaire was conducted in both an online and a paper- version to apply to students from all semesters. The survey responses were anonymous. Students and student tutors indicated their level of agreement with the items using a five-point Likert scale, from 0 = I strongly disagree to 4 = I strongly agree. We used the same Likert scale as Schmidt & Moust [7] and Vaughan & Macfarlane [27] but changed the endpoints from 1 to 0 and 5 to 4. Social congruence was measured with items such as "The tutor proved to be interested in me as student and learner" or "There was a supporting and trustful learning basis between tutor and students". Measures of cognitive congruence were similar to questions such as "The tutor was able to explain issues adapted to the students' language and knowledge" or "The tutor asked students questions they were well able to understand". The questionnaire was separated into students' and student tutors' view. Students could only answer the students' perspective. Student tutors could fill the students' as well as the student tutors' perspective.

### Statistical analysis

The questionnaire was evaluated quantitatively using IBM SPSS Statistics version 25 and Amos 25. Mean values, standard deviations, frequencies, and percentages of relevant factors were calculated. Missing data were replaced by parameters using the full information maximum likelihood method. The overall mean of missing values was estimated as 1.28%. Missing values were considered only if at least 80% of each of the questionnaires had been completed.

To assign the items to factors of cognitive and social congruence, exploratory factor analysis for students'

sample and confirmatory factor analysis for student tutors' sample were conducted, respectively. For the exploratory factor analysis the principal component analysis was used as method of extraction and varimax rotation was determined as method of rotation. The number of factors of the exploratory factor analysis were determined to be two based on the Kaiser Criterion, also called the Eigenvalue Rule [29, 30] and scree plot [31]. Previously, the correlation structure was checked by regarding the correlation matrix and its inverse one. Further, we calculated the Kaiser-Meyer-Olkin (KMO-) value and conducted the Bartlett's test of sphericity [32–34]. The prerequisites for the factor analysis were examined and given (please see results for details).

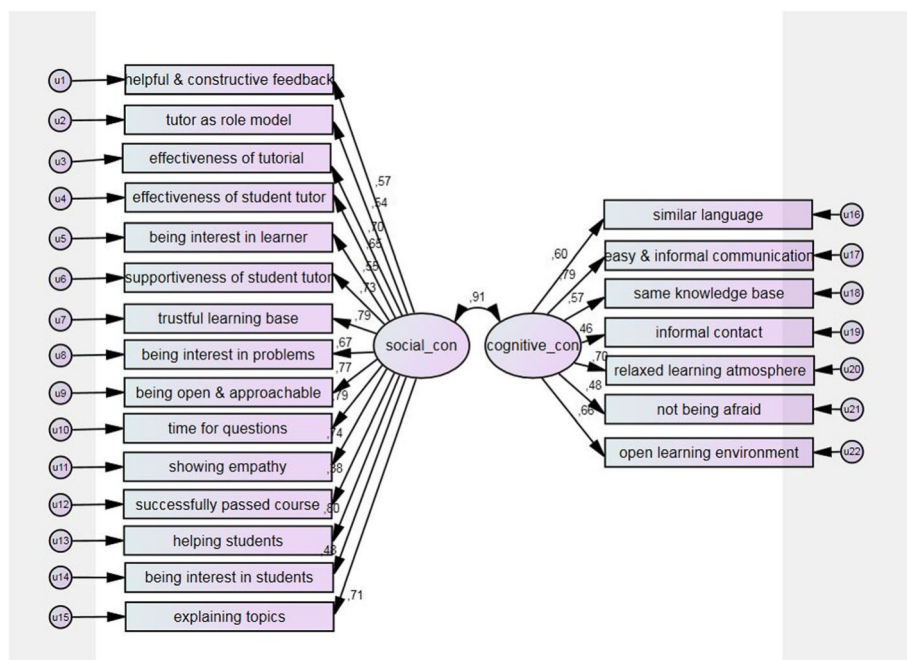
To interpret the factors, rotated factor loading was used. Factors were interpreted if at least four variables had a load of  $\pm 0.6$  or higher or if at least 10 variables had a load of  $\pm 0.4$  or higher. Item 6 ("Tutors asked understandable questions") and item 23 ("Tutor and I share similar roles") were eliminated because of their loading less than  $\pm 0.2$ . The reliability was tested using Cronbach's alpha coefficient.

To examine the resulting factor model based on exploratory factor analysis, a confirmatory factor analysis with student tutors' data was conducted. There was no significant difference between the students and student tutors. Robust maximum likelihood was used for parameter estimation. The model specification can be seen in Fig. 1. For the evaluation of the model fit, the following fit indices were applied: Chi-Square test, the quotient of Chi-Square and degrees of freedom, Root Mean Square Error of Approximation (RMSEA), and Comparative Fit Index (CFI). For a good model fit, the quotient of Chi-Square and degrees of freedom was  $\leq 2.5$  [35]. Regarding the RMSEA, a value of  $\leq 0.05$  was interpreted as a close fit; a value of  $\leq 0.08$  was interpreted as an acceptable fit [36]. For CFI, a cut value of  $\geq 0.9$  was applied as acceptable and  $\geq 0.95$  as good fit [37, 38].

## Results

### Samples

Six hundred seventy-six (RR = 79.5%) medical students, where 22.1% taught as student tutors (RR = 60.8%), filled in the questionnaire; 59.4% were female, and the average age was  $M = 24.17 \pm 3.84$ . The medical students came from different years of study (15.3% = 1st year of study, 26.9% = 2nd year of study, 26.0% = 3rd year of study, 14.9% = 4th year of study, 11.6% = 5th year of study, 5.0% = final year). As to be expected, student tutors came, on average, from more advanced years of study (0.7% = 1st year of study, 6.2% = 2nd year of study, 28.7% = 3rd year of study, 24.0% = 4th year of study, 34.3% = 5th year of study, 6.2% = practical year). Please see Table 1 for single items.



**Fig. 1** Confirmatory factor analysis of cognitive and social congruence. The graphic shows the correlation of cognitive or social congruence with the various items and their residuals. Social and cognitive congruence are highly correlated with  $r = 0.91$ . Item 5, e.g., presents being interested in students' problems. Item 12, e.g., presents similar language

**Table 1** Descriptive data of the single items

Items	Medical Students		Student Tutors	
	Mean	SD	Mean	SD
I1 Same knowledge base	2.60	0.88	2.30	0.90
I2 Similar language	3.34	0.75	3.21	0.92
I3 Preferring informal contact	2.83	0.92	3.21	0.86
I4 Student wasn't afraid to tell tutor if they didn't understand anything	3.22	0.88	2.95	1.03
I5 Being interested in students' needs and problems	2.99	0.85	3.40	0.65
I7 Helping students	3.20	0.76	3.34	0.76
I8 Tutor was able to explain students the topics based on their language and knowledge base	3.25	1.51	3.34	0.74
I9 Taking time for questions	3.20	0.79	3.62	0.69
I10 Supportiveness of student tutor	3.08	0.82	3.44	0.76
I11 Showing empathy	2.88	0.82	3.30	0.74
I12 Being interested in student as learner	2.72	0.84	3.14	0.73
I13 Effectiveness of the student tutor	2.52	0.89	2.80	0.76
I14 Being open and approachable	3.21	0.75	3.53	0.67
I15 Helpful and constructive feedback	2.34	0.92	2.82	1.01
I18 Seeing tutor as role model	2.14	1.06	2.55	0.96
I19 Stress-free and relaxing learning atmosphere	2.80	1.00	3.01	0.96
I20 Being interested in students	2.21	1.04	2.69	0.94
I21 Easy and informal communication	3.11	0.83	3.43	0.73
I22 Trustful learning base	2.81	0.82	3.24	0.76
I23 Creating an open and non-judgmental learning environment	2.90	0.82	3.30	0.75
I24 Successfully passed the course	2.55	1.26	2.85	1.08
I26 Effectiveness of tutorial	3.12	0.87	3.42	0.82

### Prerequisites for exploratory factor analysis

The correlation structure was suitable because the inverse correlation matrix represented a diagonal one with values outside the diagonal close to zero while the values of the diagonal are higher. In order to reduce data the principal component analysis (PCA) was used as method of extraction and varimax rotation was determined as method of rotation. The KMO value was marvellous with 0.96 [32, 33]. Additionally, the Bartlett's test of sphericity [34] showed that the variables were not completely uncorrelated ( $\chi^2$  (231,  $N = 527$ ) = 5397.75,  $p < .001$ ). The number of factors of the exploratory factor analysis were determined to be two based on the Kaiser Criterion, also called the Eigenvalue Rule [29, 30] and scree plot [31]. For students, the scree plot and the Kaiser Criterion indicated a two-factor solution with Eigenvalue (1) = 9.92, Eigenvalue (2) = 1.32 and an overall variance of 51.07%. Please see appendix for more detailed results.

### Exploratory factor analysis: students

The exploratory factor analysis for students resulted in a two-factor solution. Based on the factor loadings, the results indicated that this two-factor solution could be assigned to cognitive (Factor 2) and social congruence (Factor 1). Cognitive congruence consisted of items that focused knowledge and learning environment with factor loadings from 0.513–0.766. The items of social congruence described the relationship and communication among students and student tutors with factor loadings from 0.401–0.693. Please see Table 2 for further details

### Prerequisites for confirmatory factor analysis

The same assumptions as for the exploratory factor analysis were examined like the correlation structure. The KMO value was also marvellous with 0.92 [32, 33]. The Bartlett's test of sphericity showed not completely uncorrelated variables with  $\chi^2$  (276,  $N = 149$ ) = 1346.92,  $p < .001$ . The results of the Kaiser Criterion and screeplot strengthened the two-factor solution with

**Table 2** Factor loadings of cognitive and social congruence

Variable	$\lambda$ (factor 1)	$\lambda$ (factor 2)	Factor	
			1	2
I 15 Helpful and constructive feedback	0.693	0.120	+	
I 18 Seeing tutor as role model	0.690	0.190	+	
I 26 Effectiveness of tutorial	0.686	0.354	+	
I 13 Effectiveness of the student tutor	0.683	0.223	+	
I 12 Being interested in student as learner	0.682	0.364	+	
I 5 Being interested in students' needs and problems	0.670	0.396	+	
I 10 Supportiveness of student tutor	0.677	0.472	+	
I 22 Trustful learning base	0.672	0.329	+	
I 14 Being open and approachable	0.661	0.400	+	
I 9 Taking time for questions	0.640	0.381	+	
I 11 Showing empathy	0.637	0.371	+	
I 24 Successfully passed the course	0.621	0.066	+	
I 7 Helping students	0.597	0.402	+	+
I 20 Being interested in students	0.527	0.380	+	+
I 8 Tutor was able to explain students the topics based on their language and knowledge base	0.401	0.072	+	
I 2 Similar language	0.175	0.766		+
I 21 Easy and informal communication	0.423	0.673		+
I 1 Same knowledge base	0.101	0.656		+
I 3 Preferring informal contact	0.139	0.634		+
I 19 Stress-free and relaxing learning atmosphere	0.433	0.575	+	+
I 23 Creating an open and non-judgmental learning environment	0.254	0.559		+
I 4 Student wasn't afraid to tell tutor if they didn't understand anything	0.461	0.513	+	+

Variables present the single items,  $\lambda$  = factor loadings and + shows which item loaded on factor 1 or 2 (cut-off:  $> .04$ ). The loadings of the single items on factor 1 and factor 2 are depicted separately. Item 1, Item 2, Item 10, Item 11, Item 17-Item 24 are self-developed based on literature. PCA as method of extraction and varimax rotation

Eigenvalue (1) = 10.80, Eigenvalue (2) = 1.42 and an overall variance of 50.91%. Please see appendix for more detailed results.

#### Confirmatory factor analysis: student tutors

After the evaluation of the students, we examined the resulting structure of the single items as a two-factor solution by conducting a confirmatory factor analysis with the student tutors' data. We considered the student tutors' data as acceptable, as they answered the same items but from their professional perspective.

The results showed the following fit indices of a two-factor solution with:

$\chi^2$  (208,  $N = 149$ ) = 298.29,  $p < .001$ ;  $\chi^2/df = 1.434$  ( $\leq 2.5$ ); RMSEA = 0.054 (90 % CI: 0.040; 0.067;  $\leq 0.06$ ) and CFI = 0.924 ( $\geq 0.90$ ).

Although the chi-square test was significant, the other fit indices indicated an adequate model fit. As shown in Fig. 1, factor loadings of the single items in relation to cognitive and social congruence were moderate to high, ranging from 0.38 to 0.80. Further information of the factor loading can be seen in Fig. 1.

#### Cronbach's alpha coefficient

The distribution of the items to cognitive and social congruence was found to be reliable, as Cronbach's Alpha of cognitive congruence was 0.817 for students and 0.842 for student tutors, and Cronbach's Alpha of social congruence was 0.913 for students and 0.927 for student tutors.

#### Discussion

The aim of this study was to examine cognitive and social congruence in their full dimensions, including students' and student tutors' behaviour in tutorials, we tested this newly constructed questionnaire on cognitive and social congruence for German-speaking countries. The results of the exploratory factor analysis presented a two-factor solution regarding medical students including factor one as social congruence and factor two as cognitive congruence. The student tutors' data confirmed this two-factor solution when conducting a confirmatory factor analysis.

#### Main findings in light of previous evidence

The items in factor one might be related to social congruence, as it represented the social relationship between students and student tutors [7, 11]. Factor two could present cognitive congruence, as the loaded factors consisted of the intellectual and professional connection between students and student tutors [3, 4, 6–8]. When focussing on the two analyses, cognitive and social congruence were based on the concrete behaviour patterns

of the student tutor and concrete aspects of the learning environment.

Our findings are mainly in line with previous research. Many studies postulated that cognitive congruence was created by sharing the same knowledge and using similar language among students and student tutors [3, 4, 6–9, 20, 39, 40]. Furthermore, cognitive congruence might contribute to a less stressful and relaxed learning atmosphere [1, 13, 41]. Social congruence could encourage student tutors to give feedback, take time for questions and react emphatically [3, 15, 16, 20, 42]. The studies of Moust & Schmidt [43] and Yew & Yong [11] postulated that student tutors showed social congruence by being more interested in students and their daily life, including needs and problems. Furthermore, social congruence contributed to a trusting and supportive learning relationship where student tutors behaved openly and in an approachable way [25, 26, 44, 45].

#### Novel findings regarding cognitive and social congruence

In contrast to previous studies, an open and non-judgemental learning atmosphere was more strongly associated to cognitive congruence and not only to social congruence [6, 7, 11, 45]. Further, easy and informal communication as well as preferring informal contact with the student tutor was associated with cognitive congruence instead of social congruence as reported in the literature [6, 7, 11, 45]. This result could be explained by informal communication being associated with the way to best impart knowledge in tutorials. Thus, informal communication as part of knowledge transfer in tutorials belonged to cognitive congruence.

Although most studies reported that peer teaching was effective due to cognitive and social congruence [2, 17, 46, 47], our results showed that the effectiveness of the tutorial as well as of the student tutor might be associated with social congruence alone. This result is strengthened by the fact that the student tutors' explanation based on the students' language and knowledge base was also related to social congruence. As stated in various communication models, the social level seems to impact the content level of tutorials and seems to be crucial for the effectiveness of student tutor and tutorial [48, 49].

#### Strengths and limitations of the study

This study could show several items in line with the literature [6, 7, 11] as well as new, interesting discoveries. This study presents the first operationalisation of cognitive and social congruence on a behavioural level of students and student tutors among German medical students. Furthermore, the student tutors' perspective of cognitive and social congruence is, firstly, assessed. As



the sample size among study participants was large and consisted of various semesters of medical education this study could be representative. However, when interpreting the results, one should remember possible limitations. We assumed an adequate model fit of student tutors' data, though the chi-quadrat test was significant, and we retained the null hypothesis. The significant chi-quadrat test could be explained by the large sample size including 527 medical students and 149 student tutors [50]. Further, several items such as helping students were associated to both cognitive and social congruence. These items might explain the high correlation among cognitive and social congruence. Thus, the question raises if cognitive and social congruence can be regarded separately.

### Implications for teaching

For teaching implications, training courses focusing on relevant behavioural aspects of cognitive and social congruence resulting from this study could be developed and implemented for student tutors. Here, student tutors could specifically practice how to interact with the students as participants to be cognitively and socially congruent. Especially regarding the increasing heterogeneity among students due to future planning of inter-professional lectures, knowledge of cognitive and social congruence at a behavioural level becomes more relevant and should be a major focus in future research of peer tutoring.

### Conclusion

This study aimed to operationalise cognitive and social congruence of students and student tutors on a behavioural level. Cognitive congruence focused on teaching in the tutorials, including similar language and shared knowledge [7]. Social congruence represented the relationship between students and student tutors such as the student tutors' general interest in the students [7, 11]. In contrast to previous studies, non-judgmental learning atmosphere and informal communication were associated with cognitive congruence instead of social congruence [6, 7, 11, 45]. Consequently, the way to best impart knowledge might result from cognitive congruence that should be also examined in future studies. Furthermore, student tutors' explanation of topics of students' language and knowledge base was related to social congruence [6–9, 12, 20]. Future studies should investigate if the social level might affect the content level in tutorials as reported by various theories of communication models and might impact the effectiveness of PAL [6, 48, 49].

### Supplementary information

Supplementary information accompanies this paper at <https://doi.org/10.1186/s12909-020-02129-x>.

**Additional file 1: Table 3.** Correlation matrix of exploratory factor analysis; all  $p$  (1-tailed)  $< .05$ . The correlation structure of the exploratory factor analysis was suitable because the inverse correlation matrix represented a diagonal one with values outside the diagonal close to zero while the values of the diagonal are higher. All  $p$ -values (1-tailed) were significant with  $< .05$ . **Table 4.** Correlation matrix of confirmatory factor analysis; all  $p$  (1-tailed)  $< .05$ . The correlation structure of the confirmatory factor analysis was suitable because the inverse correlation matrix represented a diagonal one with values outside the diagonal close to zero while the values of the diagonal are higher. All  $p$ -values (1-tailed) were significant with  $< .05$ . **Table 5.** Total variance explained of exploratory factor analysis. The total variance explained of exploratory factor analysis indicated a two component solution with 51.07% variance. The extraction method based on the Principal Component Analysis. **Table 6.** Total variance explained of confirmatory factor analysis. The total variance explained of confirmatory factor analysis presented a two component solution with 50.91% variance. The extraction method based on the Principal Component Analysis.

**Additional file 2: Figure 2.** Screeplot exploratory and confirmatory factor analysis. Both screeplots presented a two-factor solution: For students (exploratory factor analysis), the scree plot and the Kaiser Criterion indicated a two-factor solution with Eigenvalue (1) = 9.92 and Eigenvalue (2) = 1.32. For student tutors (confirmatory factor analysis), the results of the Kaiser Criterion and screeplot strengthened the two-factor solution with Eigenvalue (1) = 10.80 and Eigenvalue (2) = 1.42.

### Abbreviations

CI: Confidence interval; CFI: Comparative fit index; Df: Degrees of freedom; KMO: Kaiser-Meyer-Olkin; RMSEA: Root mean square error of approximation; I: Item; PAL: Peer-assisted learning; PCA: Principal component analysis

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### Authors' contributions

TL and AHW were responsible for the design and conduction the study, as well as acquisition, analysis and interpretation of data. TL drafted the first version of the manuscript. TL and RE were involved in data analyses and interpretation and RE revised the manuscript critically. CN, KG, FJ and SZ made substantial contributions to the study design and revised the manuscript critically. AHW revised the manuscript critically. All authors approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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### Availability of data and materials

The datasets used and/or analysed during this study are available from the corresponding author on reasonable request.

### Ethics approval and consent to participate

The study received ethical approval from the Ethics Committee of Tuebingen Medical Faculty (No. 129/2017BO2) in April 2017. All medical students and student tutors provided their written informed consent.

### Consent for publication

Not applicable.

### Competing interests

On behalf of all authors, the corresponding author states that there is no conflict of interest or, for a single-authored work.

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