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Exploring the Relationships between Perceptions of Tutoring and Tutoring Behaviours: A Focus on Graduate Students Serving as Peer Tutors to College-Level Chemistry Students

Jonathan B. Velasco and Marilyne Stains*

It has been established that both tutors and tutees gain from tutoring sessions. However, tutors’ benefits may be enhanced or limited depending on the type of behaviours they perform during the tutoring sessions. Although behaviours enhancing both tutor and tutee learning can be promoted by training, generalized tutor training models that are often used do not take into account tutors’ preexisting perceptions of tutoring, which may guide their instructional behaviours. The goals of this multiple-case study of three chemistry tutors are to characterize their perceptions of tutoring, their behaviors during tutoring sessions, and the connections between their perceptions and behaviors. Data was collected through interviews in which tutors’ perceptions of tutors and tutoring were probed and through video recordings of three to four sessions for each tutor. Interviews were analyzed using a thematic analysis approach. Video recordings of sessions were analyzed using a list of codes corresponding to different types of behaviours that had been reported in prior tutoring studies. Analysis of the interviews indicated that tutors’ perceptions of tutoring did not overlap fully across all the three tutors. Cross-case analysis indicates that tutors’ perceptions of tutees and of the role of tutor were reflected in the instructional behaviours the tutors enacted during the sessions. The results of this study may be used to improve tutor training programs, particularly through examining individual tutor’s perceptions of tutoring as this may help anticipate natural instructional preferences of tutors.

Introduction

Historically, peer tutoring has been defined across cultures and students learning from other students (Allen, 1983). Today tutoring is omnipresent at the college level and plays a critical role in supporting the success of undergraduate students in chemistry (e.g. Bailey, 2010; Ding and Haruskamp, 2010; Krajcik and Yager, 1987; Webster and Hooper, 1998). In the United States, undergraduate students enrolled in chemistry courses often have free access to tutors through formal channels such as the Peer-Led Team Learning programme (Gafney and Varma-Nelson, 2007) and institutional learning centres where students may ask teaching assistants for help with specific assignments outside of class (Bailey, 2010). However, they may also hire a private tutor for a small hourly fee. These private tutors are upper-level undergraduate students majoring in chemistry or chemistry graduate students. They are conducting this private tutoring independently of the department. The agenda for the tutoring session depends on the tutee’s and tutor’s pre-arranged agreement.

Despite the presence of tutoring on college campuses and within chemistry departments, few studies have investigated processes associated with positive impacts of tutoring chemistry at the postsecondary level. Most tutoring studies have been conducted at the K-12 level and have focused on reading and mathematics. Moreover, studies on processes of tutoring have often been conducted under controlled, experimental conditions using tutors with low content knowledge (e.g. Chi, Siler, Jeong, Yamauchi, and Hausmann, 2003; Ismail and Alexander, 2005; King, Staffieri, and Adelgais, 1998; Roscoe and Chi, 2004) rather than more naturalistic settings with knowledgeable tutors and curricula and behaviours not controlled by external entities.

Most processes studies have been focused on identifying tutors’ and tutees’ effective behaviours. However, it has been suggested that tutors’ perceptions of tutoring can influence how tutors behave during tutoring sessions (Foot, Shute, Morgan, and Barron, 1990) and that the relationship between perceptions and behaviours should be further explored (Roscoe, 2007; Roscoe and Chi, 2007, 2008). The present study addresses this suggestion by investigating the relationship between chemistry tutors’ perceptions of tutoring and their instructional behaviours during tutoring sessions.

Behaviours underlying tutoring effectiveness

Extensive research on peer tutoring has demonstrated its positive effect on both the tutees (Cohen, Kulik, and Kulik, 1982; Fantuzzo, King, and Heller, 1992; Topping, 1998; Topping, Peter, Stephen, and Whale, 2004) and the tutors (Cohen et al., 1982; Roscoe and Chi, 2007, 2008). Roscoe and Chi (2007) have labelled the latter outcome the tutor-learning effect. Interestingly, meta-analyses conducted on this effect have measured small effect sizes and identified inconsistencies...
between studies (Cohen et al., 1982; Cook, Scruggs, 1989). Mastropieri, and Casto, 1985; Mathes and Fuchs, 1998). Rohrbeck, Ginsburg-Block, Fantuzzo, and Miller, 2003). Roscoe and Chi (2007, 2008) have argued that these results can be explained by studying the behaviours tutors enact during tutoring sessions. In particular, they identified two categories of behaviours based on their reviews of studies exploring tutors’ perceptions of tutoring. First, the lead if the tutee was not prepared. The act of demonstrating that without reminders of their training, tutors described their tutees as lacking in critical thinking and promoting interaction. Interestingly, they found differences in the distribution of tutors across these factors. For example, science tutors were more likely to value student support and over transmission of knowledge when compared to humanities tutors. Similar factors were found in Xiao’s (2012) study, where tutors’ and students’ perceptions of the tutor’s influence on students’ motivation to learn English in a distance-learning university environment were unpacked through essays.

Bailey’s (2010) study did not directly examine chemistry tutors’ perceptions of their tutees, but these were revealed extemporaneously during the interviews. The ‘walk-in’, or non-appointment tutors described their tutees as lacking in critical knowledge, being unprepared for the tutoring sessions, and unaware of what they do not know. In contrast, the appointment-based ‘learning centre’ tutors were not as explicit with describing their tutees, instead describing strategies that may address tutees’ deficiencies, such as taking the lead if the tutee was not prepared.

There are several gaps in the literature regarding tutors’ perceptions of tutoring. First, it has been found that tutors’ perceptions of tutoring vary with disciplines. Unfortunately, only one of the aforementioned studies (Bailey, 2010) have been conducted explicitly on chemistry tutors; the other studies were concerned with other science domains (Galbraith and Winterbottom, 2011; Jelfs et al., 2009), communications expertise, and pastoral care (i.e. caring for students), and vocational guidance. The latter three factors were common to those identified with students but also included critical thinking and promoting interaction. Interestingly, they found differences in the distribution of tutors across these factors. For example, science tutors were more likely to value student support and over transmission of knowledge when compared to humanities tutors. Similar factors were found in Xiao’s (2012) study, where tutors’ and students’ perceptions of the tutor’s influence on students’ motivation to learn English in a distance-learning university environment were unpacked through essays.

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Jelfs et al. (2009) investigated perceptions of effective tutoring by 457 college students and 602 tutors using a survey containing 51 descriptors of good tutors; these included “a good tutor gets students to interact” and “a good tutor is an expert in their subject.” A factor analysis on these descriptors revealed different factors for the students and the tutors. Tutors’ factors included active learning, transmission of knowledge, supporting learning, subject expertise, pastoral care (i.e. caring for students), and vocational guidance. The latter three factors were common to those identified with students but also included critical thinking and promoting interaction. Interestingly, they found differences in the distribution of tutors across these factors. For example, science tutors were more likely to value student support and over transmission of knowledge when compared to humanities tutors. Similar factors were found in Xiao’s (2012) study, where tutors’ and students’ perceptions of the tutor’s influence on students’ motivation to learn English in a distance-learning university environment were unpacked through essays.

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The goal of this study was to characterise untrained chemistry tutors’ perceptions of tutoring and examine the extent to which these perceptions are related to their behaviours during tutoring sessions. In particular, the research questions for this study are:

1. What are tutors’ perceptions of tutoring?
2. To what extent do tutors’ perceptions of tutoring relate to their behaviours?

The findings from this study may aid in making chemistry tutor training programs more effective by providing a way for trainers to predict natural behavioural tendencies of future chemistry tutors based on an assessment of their tutoring perceptions. Tailoring the training to address these natural tendencies (either enhance them if productive or diminish them if unproductive) may result in enriched learning experiences for both tutors and tutees.

Methods

Methodological approach

The study took place at a research-intensive university in the Midwestern United States. Chemistry tutors were recruited through direct e-mail contact. Emails were obtained from bulletin boards and list that tutors use to advertise their services. We chose tutors who were not part of a structure (e.g., tutoring program) in order to capture the natural tendencies, uninformed by training. This population will help us capture the clearest link between perceptions of tutoring and behaviours during tutoring sessions. Consent was obtained from both tutors and tutees as required by the approved Institutional Review Board protocol. Pseudonyms are provided to protect their anonymity.

A multiple-case study approach (Yin, 2009) was used in this study to examine the processes of tutoring across different contexts that are similarly bounded (Miles and Huberman, 1994, p. 29). In this study, each case (Table 1) was bound by the participating tutees and the courses that they were taking when the observations were made.

Study participants

The study was limited to a convenience sampling method due to the voluntary nature of tutoring. Three tutor-tutee(s) pairs agreed to participate in the study. Characteristics of the tutors are provided in Table 1. The tutees were students enrolled in the general or organic chemistry courses offered at this institution.

Data collection

Roscoe and Chi (2008) suggested that the connections between role perceptions and behaviours may be explored through the use of interviews of tutors and observations of tutoring sessions. We chose this approach and added one short survey.
Tutors were first asked to respond to an online survey which provided us demographics and background information regarding prior tutoring experience and training (Table 1). The modified semi-structured interview protocol that examined different aspects of their perceptions of tutoring (Albrecht, 1985) was used. The following is a partial list of questions from Appendix A for the complete list of questions and interview materials:

- What is tutoring?
- What is the role of the tutor?
- What are the characteristics of good/bad tutees?
- What are the characteristics of good/bad tutoring sessions? (characteristics of effective tutoring sessions)
- What are the characteristics and actions of good/bad tutors?

Each interview lasted 45-60 minutes and was carried before the first video-recorded session. The tutoring sessions, which typically lasted 60 minutes, were video recorded. In order to minimize the influence on behaviours, tutors and tutees were not given tutoring topics or behavioural cues. Reaction to the presence of the camera or research team (Albrecht, 1985) decreased through the use of small video cameras. Tutoring sessions took place in a small interviewing room, which contained a circular table, four chairs, and a whiteboard.

### Analysis

Interviews were coded to identify emerging patterns (Miles and Huberman, 1994). Two researchers independently coded the interviews to address reliability of code definitions, and a coding dictionary was compiled in order to increase the dependability of the results (Patrick et al., 2011).

Observation videos were analysed using a coding dictionary compiled from studies on tutoring behaviours; these include explanations (Graesser and Person, 1994), feedback (Chi et al., 2001), questions (Lang, Dumais, Graesser, and Kilman, 1992; Lehnerdt, 1978), and scaffolding behaviours (Chi et al., 2001). Each code was classified as KT or KB. Appendix B provides the list of codes and their classifications. For example, behaviours in which tutors provided elaboration onto confirmatory feedback was coded as KB feedback, as this involves further construction of knowledge (Graesser, Person, and Magliano, 1995), while unelaborated feedback (e.g., you are correct) was coded as KT feedback since it did not require more explicit construction (Roscoe, 2007). However, some behaviours could not be characterised as KB or KT (Appendix B3), such as common ground questions, which ask how well the tutee has understood or could follow the material (Graesser and Person, 1994). Moreover, explanations and elaborated feedback were further categorized as conceptual, procedural, factual, and bridging (Appendix B4). For example, statements are considered as procedural if tutors engage students with algorithmic material, while statements are considered as procedural if tutors engage students with algorithmic material. Videos were coded by two researchers to address reliability. Inter-rater reliability for interviews and observations were measured using pooled kappa (de Vries, Elliott, Kanouse, and Teleki, 2008). A pooled kappa above 0.80 was achieved for both sets of data.

### Results

Before presenting individual cases, we first identify the prevalent types of behaviours that were observed across all tutoring sessions and follow with a presentation of the results for each individual case.

#### Prevalent behaviours

<table>
<thead>
<tr>
<th>Tutor</th>
<th>Explanation</th>
<th>Feedback</th>
<th>Question</th>
<th>Metacognition</th>
<th>Scaffolding</th>
<th>Other behaviours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chuck</td>
<td>27% ± 17%</td>
<td>28% ± 11%</td>
<td>24% ± 5%</td>
<td>6% ± 3%</td>
<td>8% ± 5%</td>
<td>7% ± 5%</td>
</tr>
<tr>
<td>Patricia</td>
<td>53% ± 5%</td>
<td>9% ± 3%</td>
<td>2% ± 1%</td>
<td>29% ± 8%</td>
<td>4% ± 4%</td>
<td>2% ± 1%</td>
</tr>
<tr>
<td>Trent</td>
<td>27% ± 6%</td>
<td>32% ± 5%</td>
<td>9% ± 3%</td>
<td>12% ± 5%</td>
<td>18% ± 5%</td>
<td>2% ± 1%</td>
</tr>
</tbody>
</table>

Table 2 Dominant behaviours observed across all sessions; percentages describe average percentage of tutor behaviours across all tutoring sessions
Perceptions of tutoring. Chuck asserted that good tutors are approachable. It is important to him that tutees feel comfortable asking him any questions: 

Chuck: “I mean the person just, you know, gets to a point where I don’t really have to explain much ’cause I like it when people really understand things ... either that or have them, not understand something but then kind of find their way with ... little ... guidance; ... kinda have them realize it’s not that bad to guess and then figure it out, you know? So it’s kind of one where I’m not as ... involved, kinda have them ... figure it out and realize for themselves that it’s not really that bad.”

These characteristics of effective tutoring somewhat align with his perceptions of the purpose of tutoring, with regards to developing the tutee’s autonomy.

Characteristics of effective tutors. Chuck felt that good tutors are approachable. It is important to him that tutees feel comfortable asking him any questions:

Chuck: “If it’s like a low-requirement, like just like a pre-requirement for their degree, then just get through the class. If they’re a chem major, get them to understand it.”

He thought that tutors should provide students with different approaches to solving problems, make them comfortable with the material so that they may be able to work on their own, and help them develop an appreciation of the content:

Chuck: “hopefully, they’re comfortable with the material they’re expected to know, you know, for their final, and ... I guess kind of appreciate it, you know, know why we’re doing it, why it’s important...”

He asserted that he was also there to answer his tutees’ questions and thought that tutees may improve their performance on exams by reproducing the skills learned during tutoring sessions.

Perceptions of tutees. Chuck asserted that they should prepare themselves for tutoring by looking over the material; if a tutee was “going at it cold,” tutoring may not be as effective and they may not be receptive to the material. Also, students should be “willing to learn,” which includes being willing to do problems on their own, ask questions of material that they do not understand, and to not expect to be “fed the answers.”

Characteristics of tutoring. In Chuck’s opinion, tutoring is effective because it is focused on one student. This 1:1 ratio allows tutors to become familiar with their tutees’ needs and adapt their tutoring approach accordingly. Effective tutoring according to Chuck happens when everything “clicks”:

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Table 3 Characteristics of recorded tutoring sessions

<table>
<thead>
<tr>
<th>Tutor</th>
<th>Tutee(s)</th>
<th>Subject</th>
<th>Session</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chuck</td>
<td>1 male</td>
<td>General chemistry</td>
<td>C1</td>
<td>Molecular geometry, Lewis structures, polarity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Molecular geometry, Lewis structures, hybridisation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Phase diagrams, crystal structures</td>
</tr>
<tr>
<td>Patricia</td>
<td>1 male</td>
<td>General chemistry</td>
<td>P1</td>
<td>Ideal gases</td>
</tr>
<tr>
<td>Trent</td>
<td>2 females</td>
<td>Organic chemistry</td>
<td>T1</td>
<td>Molecular orbital theory</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>T2</td>
<td>Molecular geometry</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>T3</td>
<td>No specific topics</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>T4</td>
<td></td>
</tr>
</tbody>
</table>

The analysis of the frequency of occurrence of tutoring behaviours across all sessions observed revealed that providing explanations and feedback were two of the three prevalent behaviours for all three tutors (Table 2). The result is aligned with prior studies (Chi et al., 2001; Graesser et al., 1995; Moore, 2009). The third most prevalent behaviour varied by tutor (Table 2) and included questioning, being metacognitive, and scaffolding.

Chuck, a second year graduate student with some tutoring experience (Table 1), was tutoring a General Chemistry student (Table 3). Session 1 (C1) and session 2 (C2) took place on consecutive days, and session 3 (C3) occurred three weeks after C1. Topics for each session are presented in Table 3.

Tutoring approach. Chuck required his tutee to email him questions or problems he was struggling with before the tutoring sessions. He then used this information to prepare by reviewing the appropriate content or solving the provided problems himself. He highlighted that he adjusts his level of effort to match the one of the tutee. During the tutoring sessions, he likes to sit side-by-side with the tutee so that they can both see what each other is writing.

Perceptions of tutoring.

Purpose of tutoring and role of tutor. Chuck believed that the purpose of tutoring is mainly to help students better understand the material. In particular, he emphasized that his role is to promote conceptual understanding rather than performing tasks “understand what they’re doing instead of just getting the homework done.” However, he also mentioned that he and tutee would be “trying to get as many [homework problems] done as possible.” This appearing contradiction may be explained by recognition that his role depends on the students’ reasons for taking the course:

Chuck: “If it’s like a low-requirement, like just like a pre-requirement for their degree, then just get through the class. If they’re a chem major, get them to understand it.”

He thought that tutors should provide students with different approaches to solving problems, make them comfortable with the material so that they may be able to work on their own, and help them develop an appreciation of the content:

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Fig. 2 Chuck’s behaviours across all sessions

<table>
<thead>
<tr>
<th>Session</th>
<th>Tutor’s speech dominance</th>
<th>Explanation</th>
<th>Feedback</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>% total codes</td>
<td>Subtype</td>
<td>% total codes</td>
</tr>
<tr>
<td>C1</td>
<td>87%</td>
<td>24%</td>
<td>KB</td>
<td>30%</td>
</tr>
<tr>
<td>C2</td>
<td>69%</td>
<td>12%</td>
<td>KB</td>
<td>38%</td>
</tr>
<tr>
<td>C3</td>
<td>94%</td>
<td>45%</td>
<td>KB</td>
<td>17%</td>
</tr>
</tbody>
</table>

* Tutor’s speech dominance = number of characters spoken by tutor/number of characters spoken by tutor and tutee

Fig. 3 Types of explanations and elaborated feedback provided by Chuck during each tutoring session. ‘Exp’ and ‘Elab’ represent explanations (KT and KB) and elaborated feedback (KB), respectively.

Chuck: “Some things are more difficult to explain, something that… probably, you know, don’t understand as well as other things; … it’s known as a challenge ‘cause you might not know as many different ways to teach it. You might have learned it one way, but it’s all you know…so it will be more difficult [to come up with other approaches].”

In the second session, Chuck asked his tutee to solve the molecular geometries of several structures. Compared to C1, he was behaving as a guide on the side in C2 as demonstrated by the drop of conversational dominance from 87% in C1 to 69% in C2 as well as the sharp decrease in the number of explanations (from 24% in C1 to 12% in C2) and increase in feedback (from 30% in C1 to 38% in C2). Moreover, the majority of feedback is unelaborated (Fig. 2). Chuck’s explanations and elaborated feedback are largely focused on helping the tutee understand the concepts behind the process of determining molecular geometry as demonstrated by the high proportion of bridging explanations/elaborations (Fig. 3). The following excerpt provides an example of this focus on conceptual understanding:

**Chuck:** So (the hybridization of those bonds) would be? **Tutee:** That would be pi.
Conversely, there’s, um, there’s 90 degrees right here, so that’s the one. Then, express the cube, express the sphere as a, you know, a function of it, right? So if you look at this one, right, uh…this might actually be pretty, I’m a little bit rusty on the, on the, uh, on the actual packing efficiency of the, the volume occupied, again if you break it down, you can figure it out.”

These behaviours are aligned with his description of the role of content knowledge mastery and tutoring: a tutor with limited content knowledge may not be able to provide the tutee with different explanations or approaches to solving problems.

Patricia

Patricia is a second year, international graduate student with little tutoring experience (Table 1). For the observed sessions, she was tutoring a General Chemistry student (Table 3). Patricia’s sessions were irregular; the first and second session (P1 and P2) were approximately five weeks apart, while the second and third session (P2 and P3) were five days apart.

Tutoring approach. Patricia’s preparation for tutoring was based on her tutee’s requests, such as homework or aid with lab questions. In the case of homework, she attempted the homework herself before the session. She often made quizzes for the tutee to take during their sessions, and these quizzes were made to supplement the material being covered.

Perceptions of tutoring.

Purpose of tutoring and role of tutor. Patricia believed that the purpose of tutoring is to help students keep up with the course content as they may have missed or misunderstood some information provided during class as well as enhance students’ grade and understanding of the content. She explained that tutoring provides a partner for the tutee to learn from and that it can help the tutee develop into more independent problem solver. She saw her role as helping tutees with the content in two different ways: one, by telling them about content they do not know:

Patricia: “I think tutoring is … not teaching, but telling what you know and to the, to the student, or to another person who doesn’t know much more than you. I think it’s not teaching, but something, uh, something like you know something, you know more things than the other person and just telling them.”

Second, by providing guidance and validation to students on their ways of thinking about the content:
I think the tutor's speech dominance is important during the tutoring session. She don't know whether they should, so sometimes that means they don't, um, that they just teach us directly, so they didn't do this. But for the other student, I always ask them questions to let them think. Because I think they can know, they can figure out by themselves, if I can give them some suggestions, some hints for the questions, so I always teach them different ways."

**Characteristics of tutoring.** With regards to effective tutoring, she asserted that tutoring should allow for the exchange of ideas and that a session where only the tutor speaks is not effective. She felt that both tutor and tutee should learn from tutoring:

> Patricia: “I think sometimes they can teach me some things, I, you know, someone has, everyone has their own ideas, but they should learn something new from others, so they always give me some ideas, which way I can teach in, uh, other lab or recitation.”

Finally, she indicated that effective tutoring encourages students to understand the knowledge rather than relying on memorization:

> Patricia: “I think the student ... remembers these formulas ... these definitions, but they can't use these definitions or formulas to their questions. So I think a good tutoring is to let them learn, not remember.”

**Characteristics of effective tutors.** Apart from being knowledgeable, Patricia described effective tutors as energetic, willing to help, and able to communicate well. They should be able to monitor their tutee's progress during the tutoring session and keep track of content coverage in lecture and the laboratory. She also felt that tutors should be prepared to answer their tutee's questions and not “figure out the questions during the tutor session”. Her perception that tutoring should help develop student’s autonomy in problem solving was also reflected in her description of effective tutors: Tutors should “let the student figure out basic chemistry
problems by themselves.” Interestingly, she thought that the effectiveness of a tutor is measured by his/her tutee’s grades.

**Tutoring behaviours.** Patricia seemed to exhibit consistent behaviour across all sessions (Fig. 4): she lectured the tutee on the various topics addressed in the sessions. This lecturing style is demonstrated by the high speech dominance (over 93% of total characters in the transcripts were own by Patricia in any given session) and the nature of her behaviours: she provided mostly KT explanations (Fig. 4) and a third (P1) to two thirds (P2 and P3) of these explanations were factual (Fig. 5).

The other dominant type of behaviour, metacognition, was dominant by a specific subtype, i.e. calls to attention, which accounted for 16%, 19%, and 26% of all behaviours observed in P1, P2, and P3 respectively. These calls to attention referred to what ‘they,’ the problem- or exam-writers, may require the students to know, such as the values of STP, perform, such as writing electron configurations. Although these instances of behaviours were not interactive in nature, these may still be considered as KB behaviours as they require tutors to evaluate and make judgments on what the students deem as important information (Roscoe, 2007). Apart from behaviours illustrated in Figure 4, Patricia assigned quizzes to her tutee in P1 and P2. However, she provided limited feedback on the tutee’s performance in each quiz. For example, after completion of the quiz in P1, Patricia does not confirm whether the tutee was correct or not instead moving into an explanation on how to solve the gas problems.

**Perceptions of tutoring and observed behaviours.** It seemed that Patricia’s perceptions of tutoring and her behaviours were dissonant. In her perception interview, Patricia indicated that the effective tutor and tutoring session provided an opportunity for the tutee to exchange ideas with a knowledgeable peer and to become independent. She had clearly stated that an ineffective session was one where only the tutor talked. However, in all three sessions that were observed, she largely dominated the conversation, which left little room for the tutee to share his ways of thinking about the material. Moreover, the explanations she provided throughout the sessions were mostly factual and this might be observed on her interview that behaviours that encourage memorization should be avoided. Highlighting to student what is important for them to know and what they should be able to do as she did extensively also reinforce rote learning. Patricia’s limited feedback on her tutee’s quizzes illustrated the dissonance between her perceptions and behaviours; although she felt that she provided validation and opportunities to “exchange ideas,” she would return to the usual mode of tutoring without providing clear feedback the tutee’s performance.

Interestingly, she had mentioned in her interview that she adapted her instructional style to her perceptions of tutees’ instructional preferences. In particular, she had indicated that since Chinese students are often taught directly, she typically told them about the materials rather than asking them questions. The tutee in these sessions was Chinese and thus her behaviours reflected these perceptions. Although there was little behavioural evidence in this study that supported her perceptions of the tutoring role as interactive, this should not be taken as evidence against her perceptions of interactive peer tutoring since we were not able to observe her with tutees from other nationalities.

**Trent**

Trent is a third year graduate student with extensive teaching and tutoring experience (Table 1). In the session we observed, he was tutoring two students about organic chemistry. He was the only tutor in this study to have more than one tutee in the same session. Trent’s tutoring sessions were mostly regular; although the first sessions (T1 and T2) were almost one month apart, while the last three sessions (T2, T3, and T4) were one week apart of each other.

**Tutoring approach.** Trent does not typically prepare for his tutoring sessions. He asked his tutee for questions or difficulties they have with each aspect of the course (lecture, laboratory, assignment) and address these in turn during the sessions. During the observed sessions, he spent a significant amount of time drawing molecular structures on the whiteboard in front of the tutes. This contrasted with the other tutors in this study who were seated at a table, close to their tutees for the entirety of each tutoring session.

**Perceptions of tutoring.**

**Purpose of tutoring and role of tutor.** Trent perceived that the purpose of tutoring is to supplement course components (e.g., lecture, recitation) by reinforcing topics introduced in these settings. In particular, he thought that tutoring is intended to provide an opportunity for students to ask clarifying questions. He felt that students may not ask questions in class because of concerns about how other students may perceive them; however, he thought that the relationship developed between the tutor and the tutee makes it easier for tutees to share their struggles. Overall, he thought that tutoring is intended to help students develop conceptual understanding and study skills. He expected that these gains would lead to greater students’ success on standardized exams such as the national medical test.

Trent: “I think that we should be trying to achieve with them ultimately learning how to review the material correctly, how to study for something and ultimately just to pick up some of these concepts because some of them are important and they will become important in classes that they will take in the future.”
I guess a good tutoring session is

- really are given answers. Practice the process of solving strengths and weaknesses and, as a consequence, come with many

<table>
<thead>
<tr>
<th>Session</th>
<th>Tutor’s speech dominance*</th>
<th>Explanation</th>
<th>Feedback</th>
<th>Scaffolding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% total codes</td>
<td>Subtype</td>
<td>% total codes</td>
<td>Subtype</td>
</tr>
<tr>
<td>T1</td>
<td>57%</td>
<td>22%</td>
<td>33%</td>
<td>25%</td>
</tr>
<tr>
<td>T2</td>
<td>56%</td>
<td>35%</td>
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<td>16%</td>
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<tr>
<td>T3</td>
<td>51%</td>
<td>22%</td>
<td>36%</td>
<td>17%</td>
</tr>
<tr>
<td>T4</td>
<td>65%</td>
<td>29%</td>
<td>33%</td>
<td>14%</td>
</tr>
</tbody>
</table>

† Subtype: Knowledge-telling, Knowledge-building, Executing skills, Complete reasoning, Other

* Tutor’s speech dominance = number of characters spoken by tutor/number of characters spoken by tutor and tutee

Fig. 6 Trent’s behaviours across all sessions

Fig. 7 Types of explanations and elaborated feedback provided by Trent during each tutoring session. ‘Exp’ and ‘Elab’ represent explanations (KT and KB) and elaborated feedback (KB), respectively

Trent felt that his role was to address the tutee’s questions by:

- providing examples and problems related to the object of confusion for them to work on. Through the process of solving these new problems, the tutor can identify the tutee’s strengths and weaknesses and help them develop the latter.
- He felt strongly, however, that it was the responsibility of the tutor to identify their questions as the following interview excerpt illustrates:

Trent: “But ultimately they [tutors] are just there to answer a question and it’s all up to the tutee to guide where they need help because as a tutor you don’t have time to observe them and watch them do your homework and so it’s up to them that a little bit of extra effort and say ‘we get this. I need more practice on this, can you help me with this example.’"

Characteristics of tutees. Trent felt that tutees should be prepared for tutoring by having identified their strengths and weaknesses and, as a consequence, come with many questions. They should not expect to solely be given answers. He perceived ideal tutees as those with personalities that are conducive to his views of tutoring. He felt that tutees that are more introverted may be more afraid to ask for help, which could make tutoring more difficult in two ways. First, as the tutor, he would not be able to actualise his role of answering tutees’ questions. Second, if the tutee was not able to ask questions, the tutoring session would not progress as the tutee would not be able to guide him towards his/her learning needs.

Characteristics of tutoring. Trent’s perceptions of effective tutoring aligned with his views of an ideal tutee and his goals for tutoring. He described the characteristics of an effective tutoring session in the following manner:

Trent: “I guess a good tutoring session is one in which the student is prepared because if they’re not prepared, it really bogs down your time because they’re like ‘well I just need my answers’ on a homework [...] so, a good characteristic of a tutor session then would be, uh, lots of questions. And so they’re asking questions, their curiosity sparked, you’re really getting the juices flowing, so to speak, and they really are interested in what’s going on, and they wanna learn more.”

Characteristics of effective tutors. He characterized effective tutors as knowledgeable, good communicators, approachable, and interested in helping students. Knowledge and communication skills aid with effective tutoring in that students may lose confidence in tutors that do not have a strong grasp of, or the ability to succinctly deliver the material. If a tutor was not able to deliver the material properly, such as strong grasp of, or the ability to succinctly deliver the material. If a tutor was not able to deliver the material properly, such as through poor penmanship or by quickly shifting between topics, tutees may not be able to clarify their concerns and may confuse them further, thus defeating the purpose of
tutoring. Finally, he thought that an effective tutor should monitor tutee’s understanding throughout the session.

Tutoring behaviours. Fig. 6 illustrates Trent’s top three dominant behaviours across all sessions. Although dominance was closer to parity, it should be noted that there were two tutees, so some portion of instruction time was conversation between the tutees (M=4%; SD=1%). Trent’s tutoring sessions were guided by his tutees’ questions and requests, many of which came from materials provided by the tutees, such as lecture reviews and laboratory assignments. Trent also asked for feedback provided by his tutees, such as lecture reviews and laboratory assignments. Trent’s role as tutor was to provide feedback and assess their performance on problems that they had solved before coming to his tutoring sessions, as well as providing explanations for important concepts, such as differences between substitution and elimination reactions. This structure was considered KT as these were tutor-initiated (Roscoe and Chen, 2007). Feedback alternated between elaborated (KB) and non-elaborated (KT) responses (Fig. 6).

The nature of the questions provided by the tutees led Trent to use different types of explanations and elaborated feedback (Fig. 7). During the first two sessions, tutees were mostly requesting help on various types of procedures: how to use the IUPAC nomenclature (T1), draw Newman projections (T1), to draw chair conformations (T1), calculate free energy (T2), and interpret spectra (T2). However, in the last two sessions, they requested help on concepts: how to determine if something is a good nucleophile (T3), determine minor and major products of a reaction (T3, T4), and to stabilize carbocation with hydride and methyl shifts (T3); they also asked Trent to provide an overview of substitution and elimination reactions (T4). This shift from procedural conceptual requests is reflected by the shift from procedural to conceptual explanations and elaborated feedback provided by Trent (Fig. 7).

Perceptions of tutoring and observed behaviours. Trent’s behaviours were fully aligned with his perceptions of tutoring instruction. Trent perceived that the goal of tutoring is to answer questions provided by the tutees and this is exactly what was observed in the sessions. The questions answered were directly tied to content tutees had seen in the lecture and laboratory component of the course, also supporting his views. Interestingly, there was a larger variation in the types of explanations and elaborated feedback he provided across sessions when compared to the other two tutors. It seems like this variation was due to the nature of tutee’s inquiries.

Cross-case analysis

What are tutors’ perceptions of tutoring?

All tutors identified the enhancement of student conceptual understanding of content taught in student courses as the general purpose of tutoring. However, they perceived their role differently. Patricia and Chuck described their role as teacher of knowledge and skills while Trent described his role as question seeker (i.e., he expects his tutees to come to the tutoring sessions with questions that they formulated themselves).

All three tutors characterized good tutees as students who come prepared to the session, having identified the help they need. Trent and Chuck highlighted that students should not expect to have the tutor do their assignments for them. Patricia was unique in identifying that tutees have different instructional preferences.

They described differently the characteristics of an effective tutoring session. Patricia and Trent preferred interactive sessions in which tutee and tutor are constantly exchanging questions, answers or ideas. Chuck, on the other end, described an effective session as one where the tutee makes progress under limited guidance from the tutor.

Finally, the characteristics of an effective tutor that Patricia, Chuck and Trent provided all related to their character: they felt that an effective tutor is approachable, knowledgeable, and communicate well. Trent and Patricia added they s/he should be interested in the tutee’s success. Patricia was the only tutor who provided pedagogical characteristics: an effective tutor should monitor their tutee’s progress and have them solve problems on their own first.

To what extent do tutors’ perceptions of tutoring relate to their behaviours?

Analyses across the three tutors of the relationship between their perceptions of tutoring and their behaviours during tutoring prompted us to make the following claims: 1) their perceptions of their tutees and 2) their perceptions of their role as tutor were related to their instructional behaviours.

Claim 1: Tutors’ perceptions of their tutee were related to their instructional behaviours. Chuck and Patricia’s behaviours during their tutoring sessions can be explained by statements about their tutee made during the interview. Patricia’s didactic approach can be directly connected to her statement about preferences of Chinese students for expository teaching style. Even though she recognized during the interview that this approach is not the most effective, it seems that she valued more her perceptions of her tutee’s preferred instructional style. Chuck indicated during this interview that he adapted his approach to his tutee’s reasons for taking the course: if the tutee takes the course as a general education requirement, the focus is on passing the course while if the tutee majors in the course, the focus is on developing understanding. His tutee fits into the former and Chuck focused the first two sessions on drills with a clear goal for the tutee to be able to replicate these drills on an exam. He did not provide different approaches to solving these problems neither conceptual explanations even though he described these behaviours as part of his role as a tutor. For both of these tutors, their
perceptions of their tutees outweighed their perceptions of effective practices and influenced their behaviours during sessions. In both cases, it led to more KT behaviours than would be expected from their descriptions of effective tutoring behaviours.

**Claim 2: Tutors’ perceptions of their role as tutor were related to their instructional behaviours.** All three tutors saw their role differently: Patricia described her role as a dispensation of knowledge (e.g., telling them what they should know and lecturing about content they are confused about), Chuck as a skill builder (e.g., providing various problem strategies, working toward developing their autonomy) and Trent as a consultant (e.g., answering tutee’s questions). These differences in perceptions are connected to their carrying out of the tutoring functions. Patricia lectured, Chuck provided teacher-centred training, and Trent provided scaffolded explanations. It seems that inquiring about one’s perception of their role as a tutor can provide insight into their enacted tutoring approach.

**Limitations**

The first limitation of this study is that the analysis was mostly focused on the verbal utterances of the tutors. Writings from the data were not included in the analysis. The second limitation of this study, which is typical of case studies, is that the findings may not be easily generalizable since the data set is too small to empirically represent the larger population (Hodkinson, 2001), even one as limited as chemistry graduate students working as peer tutors. However, the behaviours observed in observed other studies, regardless of the exact nature of peer tutoring. The tutors’ perceptions of tutoring is support by the literature, while similar predominance of KT behaviours observed in this study have been observed in Bailey’s study (2008) of ‘learning centre’ and ‘academic department’ chemistry tutors (2010) and in Berghmans et al.’s study of mathematics tutors (2013). Thus, this study fulfills the functions of offering important evidence to complement experiments”, as asserted by Yin (2009, p. 16), expanding the literature and theories of student perceptions and behaviour as well as demonstrating relationships between them.

**Conclusions and Implications**

This study provides insight into the relationship between perceptions of tutoring in chemistry and tutoring behaviours. In particular, we found that tutors’ perceptions of their tutee’s and their role as tutor are indicative of the instructional approach they enact during tutoring sessions. Although studies need to be conducted in order to explore further relationship, findings provided within this study along prior research on the impact of practical teaching experiences instructional practices at the college level suggest that the training program and, potentially, teaching assistant training program should assess and take into account their instructors’ perceptions of their teaching environment as these may unravel instructors’ tendencies and preferences for certain types of instructional practices.

**Acknowledgements**

The authors would like to thank the study participants and the University of Nebraska–Lincoln for financial support.

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Investigating the Tutor Learning Effect: Relationships between Tutors’ Perceptions of Tutoring and Tutors’ Productive Behaviours

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Department of Chemistry
University of Nebraska – Lincoln

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Appendix A - Interview Materials

A1. Interview protocol to examine tutors’ perceptions of tutoring

1) What is tutoring?
2) What is the role of the tutor?
3) Let’s talk about a typical tutoring session with you.
   a. Where do you typically conduct your tutoring session?
   b. Do you typically prepare for a tutoring session?
      i. (if yes) How do you prepare?
      ii. (if no) Why not?
   c. Do you interact, prepare, or conduct the session differently with different tutees?
   d. What do you do in between tutoring sessions?
   e. Please describe a typical tutoring session from beginning to end.
4) What are the characteristics of good and bad tutees? Please use this chart (Appendix A1) to organize your thoughts.
5) What are the characteristics of good and bad tutoring sessions? Please use this chart (Appendix A2) to organize your thoughts.
6) What are the characteristics, skills, and actions of good and bad tutors? Please use this chart (Appendix A3) to organize your thoughts. If you can, use different colors of the pens provided to differentiate between characteristics, actions, and skills.
7) Please compare and contrast the characteristics, actions, and goals of tutors and teaching assistants (TAs). You may use this chart (Appendix A4) to organize your thoughts. If you can, use different colors of the pens provided to differentiate.
8) Please compare and contrast the characteristics, actions, and goals of tutors and lecturers. You may use this chart (Appendix A5) to organize your thoughts.
9) What is the purpose of tutoring?
10) What do you think are the main goals of a tutoring session?
11) What are you trying to achieve throughout the entire semester?
12) In your opinion, what is the most important thing that you do as a tutor?
13) Do you find tutoring challenging? Why (or why not)?
14) Why do you tutor?
15) Do you think you get something out of being a tutor?
A2. Chart used to identify the characteristics of tutees

Characteristics of a ____ Tutee

<table>
<thead>
<tr>
<th>Good</th>
<th>Bad</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A3. Chart used to identify the characteristics of tutoring sessions

<table>
<thead>
<tr>
<th>Characteristics of _________ Tutoring Sessions</th>
<th>Good</th>
<th>Bad</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Characteristics, Skills, and Actions of a _________ Tutor

<table>
<thead>
<tr>
<th>Good</th>
<th>Bad</th>
</tr>
</thead>
</table>

A4. Chart used to identify the characteristics, skills, and actions of tutors
A5. Chart used by interviewees to compare resource room teaching assistants (TAs) and tutors
A6. Chart used by interviewees to compare lecturers and TAs

Characteristics  Actions  Goals

Lecturer

TA
Appendix B - Coding Book

B1. Codes used to examine tutors’ behaviours, with operational definitions of knowledge-telling (KT) and knowledge-building (KB) behaviours

<table>
<thead>
<tr>
<th>Tutor behaviour</th>
<th>KT definition</th>
<th>KB definition</th>
<th>Non KT/KB definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explanations</td>
<td>Didactic lectures with little tutee participation (Fuchs et al., 1994; Fuchs et al., 1996)</td>
<td>Responses to tutees’ information-seeking questions (Roscoe, 2007)</td>
<td>N/A</td>
</tr>
<tr>
<td>Feedback</td>
<td>Unelaborated, yes/no responses (Roscoe, 2007)</td>
<td>Tutor elaborating on tutee’s answer (Graesser et al., 1995)</td>
<td>N/A</td>
</tr>
<tr>
<td>Questions</td>
<td>Questions that “did not contain or require any information beyond the text contents” (Roscoe and Chi, 2004)</td>
<td>Questions that “manifested logical reasoning, causal reasoning, or goal-oriented reasoning” (Graesser et al., 1995)</td>
<td>Common ground question: Question that asks how well the listener is understanding or following along (Graesser and Person, 1994)</td>
</tr>
</tbody>
</table>
### B2. Codes used to examine other knowledge-building behaviours

<table>
<thead>
<tr>
<th>Code</th>
<th>KB definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tutor’s metacognitive behaviours</strong></td>
<td></td>
</tr>
<tr>
<td>Memory</td>
<td>Tutor statements related to their own abilities to recall information (Roscoe, 2007)</td>
</tr>
<tr>
<td>Comprehension</td>
<td>Tutor statements that focused on their own understanding of the material (Roscoe, 2007)</td>
</tr>
<tr>
<td>Attention</td>
<td>Tutor statements that indicated their perceptions of what was important in the material (Roscoe, 2007)</td>
</tr>
<tr>
<td><strong>Tutor’s scaffolding behaviours</strong></td>
<td></td>
</tr>
<tr>
<td>Highlighting critical features</td>
<td>Orienting tutee to important features of the problem (McArthur, et al., 1990)</td>
</tr>
<tr>
<td>Decomposing the task</td>
<td>Breaking up a complex task into simpler tasks (see Chi, et al., 2001)</td>
</tr>
<tr>
<td>Executing part/s of the skill</td>
<td>Carrying out part/s of an activity (Rogoff, 1990)</td>
</tr>
<tr>
<td>Compare current problem with a previously-solved problem</td>
<td>Statements regarding similarities between current and previous problems (McArthur, et al., 1990)</td>
</tr>
<tr>
<td>Identifying/maintaining goal orientation</td>
<td>Tutor statements that keep the tutees on task towards a goal (Wood, et al., 1976)</td>
</tr>
<tr>
<td>Completing student reasoning</td>
<td>Correcting student errors without acknowledging errors (Graesser, et al., 1995)</td>
</tr>
<tr>
<td>Providing examples</td>
<td>Tutor statement that provides a relevant example (Chi, et al., 2001)</td>
</tr>
<tr>
<td>Evaluate solution</td>
<td>Evaluating the quality of student answers without confirming its accuracy (Graesser, et al., 1995)</td>
</tr>
<tr>
<td>Hints (as statements or as questions)</td>
<td>Tutor providing hints to the tutee in order to solve a problem (King, et al., 1998)</td>
</tr>
<tr>
<td>“What else” question</td>
<td>Tutor asks a probing question to have students expand on their responses (Graesser, et al., 1995; King, et al., 1998)</td>
</tr>
</tbody>
</table>

### B3. Codes used to describe other, non-KB/KT behaviours

<table>
<thead>
<tr>
<th>Tutor’s non-KB/KT behaviours</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading text sentence</td>
<td>Tutor reading text directly from a book or other source</td>
</tr>
<tr>
<td>Requests</td>
<td>Tutor requests the tutee to perform an action</td>
</tr>
</tbody>
</table>
B4. Types of explanations and elaborated feedback

<table>
<thead>
<tr>
<th>Classification</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Conceptual</td>
<td>Tutor engages the tutee with the conceptual underpinnings of the material</td>
</tr>
<tr>
<td>Procedural</td>
<td>Tutor engages the tutee with algorithmic steps for problem solving (Fuchs et al., 1994)</td>
</tr>
<tr>
<td>Bridging</td>
<td>Tutor engages tutee with procedural statements connected to underlying concepts</td>
</tr>
<tr>
<td>Factual</td>
<td>Tutor engages tutee with stand-alone definitions and facts</td>
</tr>
</tbody>
</table>

B5. Literature cited


