Comparing Older and Younger Siblings' Teaching Strategies and their Use of Internal State Language during Naturalistic Home Observations

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Abstract

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The bidirectional nature of siblings' influence on each other's cognitive development was examined within the context of naturalistic teaching. The purpose of the present study was to compare 38 sibling dyads from four to seven years of age on measures of teaching strategies, initiation of teaching, learner's response to teaching, and children's use of internal state language. Pearson correlations revealed that the older sibling's age was not related to these variables, while younger siblings' age was negatively associated with their use of positive feedback. No gender effects were found using a series of *t*-tests. A repeated measures ANOVA was used to compare older and younger siblings' teaching strategies. Results indicated that older siblings used more demonstration, positive feedback and negative feedback compared to younger siblings during teaching. Significant main effects were found for children's use of internal state language, who initiated teaching, and learner response. Overall, both siblings' referenced more goals than cognitions during teaching. Furthermore, the majority of sibling teaching sequences were initiated by the teacher rather than requested by the learner. Older siblings' references to cognitions were positively associated with younger siblings' active involvement and younger siblings' use of planning was positively correlated with their older siblings' active involvement. These findings have a number of implications for understanding how siblings contribute to each other's social-cognitive development.

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Statement of the Problem

Within child development literature it is clear that children's development of social understanding is fostered by their experiences with others and that children's close relationships provide important contexts for the development of social understanding and cognitive development (Carpendale & Lewis, 2004). The majority of the literature on children's social understanding has focused on two types of relationships: complementary and reciprocal (Howe, Ross, & Recchia, 2011). The sibling relationship in particular is exceptional given that it encompasses both types of interactions (Howe et al., 2011).

There is an elegance with which siblings are able to influence one another's development. Early childhood sibling interactions observed in the home provide some of children's first experiences concerning teaching and learning. For example, siblings' use of internal state language has been found to contribute to their development of social understanding (Jenkins, Turrell, Kogushi, Lollis, & Ross, 2003). This study illustrates siblings' indirect influence on one another, whereas other investigations focus on more direct teaching efforts. Notably, there are only a handful of studies that have examined older siblings' ability to teach their younger sibling (e.g., Howe, Brody, & Recchia, 2006; Klein, Feldman, & Zarur, 2002), which have typically employed a semi-structured experimental design. To our knowledge, there is only one empirical case of an examination of younger siblings' abilities to teach their older sibling (Recchia, Howe, & Alexander, 2009), although there may be anecdotal (e.g., Dunn, 1988) or ethnographic (e.g., Maynard, 2004) examples in the literature. Importantly, Recchia et al. (2009) assigned the teacher role to the younger sibling in half of the dyads for this experimental design. At present, there is no research available concerning younger sibling teaching in

naturalistic contexts; as such, this phenomenon warrants further investigation. It is important to examine the frequency of younger and older siblings' teaching in naturalistic contexts, along with the strategies they employ and their use of internal state language during teaching as a means to understand better the bidirectional interactions that take place during sibling teaching, which ultimately influence their cognitive development. This forms the basis of the current study.

This literature review examines different approaches to teaching and the learner's active role in the teaching process. Following this, specific teaching strategies that have been investigated in the literature are summarized. Later, the sibling relationship is discussed as an important context for teaching. In addition, internal state language, a marker of social understanding, is discussed in relation to its contribution to successful teaching.

Introduction

Teaching has been defined as the intention of one individual to transfer information or a skill to another individual (Ziv & Frye, 2004). Social constructivists argue that this typically follows a path from a more knowledgeable person to a less knowledgeable person (Palinscar, 1998). Underlying many definitions of teaching is the idea of an expert teaching a novice. Research that has examined how children engage in teaching other children has focused on two factors: the intention to teach and an awareness of a disparity in the understanding or skills between the individuals involved in the teaching situation. These two elements are considered central to children's understanding and ability to teach. Moreover, Ziv and Frye (2004) contend that an, "awareness of a difference in knowledge is a prerequisite for teaching" (p. 458). Some researchers maintain that

individual differences in social understanding occur because children gradually acquire new skills through their experiences with others (e.g., Carpendale & Lewis, 2004). These social constructivist views mirror Rogoff's (1998) notion of guided participation, which places emphasis on the process involved in teaching. She discusses three main goals for guided participation: To "build bridges" when a gap in knowledge is apparent (i.e., between the known and the unknown), to provide structure and support for the learner's involvement, and to foster the learner's responsibility during problem solving. With this Rogoff underscores the value of providing verbal information and physical help for the learner to achieve the desired outcome, the process of learning.

Approaches to Teaching

The process of teaching involves a certain amount of control on the part of the teacher and input on the part of the learner. Children often struggle when attempting to balance the degree of instruction they provide with defining their role as the teacher. Two types of teaching approaches emerge from this struggle: teacher-centered and learner-centered approaches to teaching (Palinscar, 1998). Clear patterns of behavior are apparent depending on the type of approach adopted.

Children who adopt the teacher-centered approach are consumed with controlling the course of the teaching and often do so at the expense of knowledge transfer (Palinscar, 1998; Rogoff, 1998). It appears as though children who adopt this type of teaching typically view the teacher's role as fixed. They use a limited number of teaching strategies, most of which maintain control of the teaching context (e.g., physical demonstration). They clearly distinguish between the role of the teacher and that of the learner and solicit little, if any, involvement of the learner.

In contrast, a learner-centered strategy encourages learner involvement. In this type of approach the teacher assumes the role of a guide or facilitator. Consequently, this role changes as the needs of the learner or the situation transform. Learner errors are handled in different ways depending on the approach the teacher has adopted (Recchia et al., 2009). This will be discussed in relation to the learner's involvement in the teaching process later in this review. It is evident that the learner-centered teaching approach is more flexible. Accordingly, it requires teachers to store a number of different tools in their teaching toolbox. Essentially, by allowing for more active involvement on the part of the learner, learner-centered teachers acquire more information concerning the learner's level of understanding, strengths, and weaknesses. This information allows them to adjust their teaching strategy to meet the needs of the learner more effectively. Clearly, the reciprocal nature of teaching highlights the role of both the teacher and the learner in this process. First, the learner's involvement in teaching will be examined, followed by an examination of specific teaching strategies that have been investigated within the literature.

Learner Involvement in Teaching

Learner involvement is a central component of the teaching process as a whole. Rogoff (1998) contends that teaching is a bidirectional process. She places importance on both individuals' roles in the exchange of information. Importantly, the learner's degree of involvement can impact their learning (e.g., Azmitia & Hesser, 1993). Learner involvement has often been found to be associated with better task performance (e.g., Azmitia & Hesser, 1993). Similarly, Howe, Recchia, Della Porta, and Funamoto (in press) also found when learners were not involved, they performed poorly on the task.

Definitions of learner involvement and task performance are not consistent within the literature. Furthermore, although it seems clear that learner involvement should not be equated with task performance, these concepts often appear to be confounded. For example, Azmitia and Hesser's (1993) term for task performance was the learner's task mastery. This measure was created based on three learner behaviors. First, they took into account the *learner's accuracy* when placing pieces during the construction task, without teacher input. Second, the *learner's questions* directed to the teacher were considered. Third, the *learner's refusal of teacher input*, specifically, not allowing the teacher to place a block that he/she would have then placed on their own, in order to complete the task or that particular segment, independently. Together these three learner behaviors were used as "indexes of the learner's task mastery" (p. 440). Notably, two out of the three learner behaviors considered appear to be more commonly recognized as aspects of learner involvement, whereas only one seems to address the child's actual task performance (accuracy of the placement of the blocks).

Klein et al. (2002) rated children's task performance from zero to four, with zero being the lowest possible score. They determined the success of the learner based on whether they could complete any portion of the task on their own. The scores were based on the level of help the learner received from the teacher; consider the requirements for a score of three on task performance:

> "3 = Younger sibling completed most of the task alone with or without indirect assistance. Indirect assistance was defined as assistance not involving demonstration or doing for the younger child including moves to enhance the younger child's motivation (e.g., 'you're almost done') or assist in the regulation of the performance process ('do this first and then that'). Minimal direct assistance was necessary" (p. 327).

This example illustrates the complexity of teaching and learning. This further complicates matters, as the learner's task performance appears to be considered in relation to the teaching strategies used and the teacher's involvement in this process. It is important to acknowledge that certain tasks within these studies may require more teacher participation, whether it is due to the nature of the task and or the level of inherent difficulty.

Research suggests that the task itself or the subject matter of the teaching may influence the level of learner involvement, independent of the teacher's behaviors (Rogoff, 1998). For example, Howe et al. (in press) presented two teaching tasks and found that learner involvement was more frequent in the tanagrams task compared to the tractor task. The authors discuss important differences among the tasks that may have impacted the teaching involved. On the one hand, the tanagrams task was a self-guided, repetitive task. Thus, while the level of difficulty increased within the task, the steps for completing it remained the same. On the other hand, the tractor task involved attaining unique subgoals, which required more input from the teacher. In this study the nature of these tasks could potentially have influenced the teaching strategies used. Markedly, no differences in performance were reported, regardless of the task; this indicates that one task was not more difficult than the other. The level of difficulty of a task is another element to consider when examining learner involvement during teaching.

Howe, Brody, and Recchia (2006) found that learner involvement was greater during a difficult task compared to an easier one. Clearly the level of difficulty inherent in the task being taught affects the level of teacher and learner involvement, which subsequently affects the children's task performance. Given the naturalistic nature of the

data in the current study, it was not possible to measure task performance, however, the degree of learner involvement was investigated.

When learners are actively involved in the teaching process there is an increased likelihood that they will make errors. For example, Recchia et al. (2009) reported that when the learner was more involved they made more errors, which was positively associated with teachers providing additional instruction. These errors have the potential to further the learner's understanding if they are given the opportunity to find the appropriate solutions independently. This is what happens in learner-centered teaching contexts. Teacher-centered approaches, in contrast, limit the learner's involvement entirely and typically correct the learner's errors without affording them this important experience.

While the approach to teaching may impact the level of learner involvement, the age of the learner also appears to be important. Some studies suggest that the learner's age may mediate the level of involvement during teaching. For example, older learners have been found to be more involved overall in the teaching process (Howe et al., in press). Specifically, older learner's involvement appears to take the form of asking questions during teaching (Howe & Recchia, 2008). Asking questions during teaching may require a certain level of comfort or familiarity between the learner and the teacher. For example, Azmitia and Hesser (1993) found more learner involvement when the teacher was the sibling than the peer. Thus, the degree of learner involvement may also be influenced by the relationship between the teacher and the learner. While learner involvement appears to be mediated by a number of variables (e.g., task difficulty, learner's age), one important area that requires clarification concerns whether certain

teaching strategies are associated with greater learner involvement, which will be addressed within this study.

Teaching Strategies

Whether they are regarded as teaching behaviors, strategies, or mediating behaviors, there appears to be commonalities between the underlying behaviors in which teachers engage. Some strategies are investigated frequently within the literature (e.g., direct instruction, demonstration, explanation, scaffolding, feedback), sometimes with different labels, but ultimately appearing to measure the same behavior. Other teaching behaviors examined are unique to specific investigations (e.g., decontextualization), nevertheless they are still important when examining techniques individuals use when teaching.

The teaching strategies examined in the literature most often include: instruction, demonstration, explanation, scaffolding, and feedback. *Verbal instruction* is often investigated when examining teaching strategies used (e.g., Azmitia & Hesser, 1993; Recchia et al., 2009). This form of teaching involves providing directives, labels, and/or verbal instructions while teaching. Necessarily, this type of strategy revolves around the teacher using spoken language to direct the learner's behaviors or provide information. Alternatively, *demonstration* can be both verbal and nonverbal. For example, some investigations measure the teacher's use of physical demonstration (e.g., Howe et al., 2006), whereas other studies consider demonstration when a teacher describes their actions while demonstrating how to complete the task (e.g., Azmitia & Hesser, 1993). Klein et al. (2002) examined "focusing", which involved verbally or non-verbally directing the attention of the learner. In this way, we could consider focusing as similar to

demonstration. This type of describing does not include efforts made by the teacher to explain the teaching. *Explanation* entails justifying why the learner should engage in a particular behavior or providing reasoning for a particular observation (Azmitia & Hesser, 1993).

A number of studies also examine teacher's use of scaffolding (e.g., Howe et al., 2006; Recchia et al., 2009). *Scaffolding* may require using a number of the strategies previously described. However, it is the manner in which they are used that warrants this distinction. Scaffolding involves the learner more directly, because in order to scaffold effectively the teacher must take into account the learner's perspective or current understanding. This strategy is more subtle than those previously discussed. For example, a teacher may arrange the materials in a way that guides the learner to select the correct piece, or they may provide verbal hints that prompt the learner. Comparable strategies within the literature include (a) "planning", which involves setting up the steps in order to teach or (b) "regulating behavior", which according to Klein et al. (2002) consists of "laying the course of action required for optimal performance through verbal or non-verbal behaviour (e.g., placing four pieces in front of the child from the pile of puzzle pieces; Saying 'let's do this piece and then that piece')" (p. 326). Finally, many investigations take into account the *feedback* the teacher provides. Two types of feedback have been examined: positive feedback (e.g., praise) and negative feedback (e.g., criticism). Some studies investigate both forms of feedback (e.g., Azmitia & Hesser, 1993), while others focus exclusively on negative feedback (e.g., Klein et al., 2002). While Klein et al., only examined negative feedback, they also looked at the teacher's

capacity for "fostering a sense of competence" in the learner, which could be considered similar to providing positive feedback.

Other teaching strategies are unique to particular investigations or researchers, but offer insight into the variety of teaching behaviors that can be used. For example, Klein et al. (2002) examined amplifying affect and decontextualization, both of which seem different than other forms of teaching behaviors described in the literature. Amplifying affect included increasing the learner's level of arousal (e.g., smiling, intonation) in order to keep the learner's interest or even heighten the level of interest in the teaching. Decontextualization promotes the learner's understanding by highlighting the similarities between the teaching task at hand and previous experiences. By relating information from other contexts, the teacher helps the learner to "build bridges" between the known and unknown.

The Sibling Relationship: An Important Context for Teaching

Without a doubt, siblings play an instrumental role in children's development. There are four distinctive characteristics of the sibling relationship that make it an influential context for teaching: strong affect, a common history, relationship quality, and non-shared environmental influences (Howe et al., 2011). Dunn (2007) argues that, "it is the emotional context and familiarity of the sibling relationship that can play an important part in the growth of understanding" (p. 319). Sibling interactions can be positively and negatively charged (Dunn, 1983). This freedom to express strong emotions within the sibling relationship may provide particularly salient socialization experiences for children. Moreover, because siblings spend a large amount of time together these experiences can lead to an intimate understanding of one another. These shared

experiences may put them at an advantage in terms of their awareness of each other's strengths and weaknesses. This, in turn, may make them more effective teachers and learners than children without this greater shared experience, such as peers. It has been found that siblings can use this information positively (e.g., during cooperative pretend play; Howe, Petrakos, & Rinaldi, 1998) and negatively (e.g., during conflict; Recchia & Howe, 2009). These experiences and range of emotions contribute to the large individual differences in sibling relationship quality that are often observed and may also impact the sibling teaching process.

In addition, the sibling relationship is exceptional given that it encompasses two types of interactions, complementary and reciprocal (Howe et al., 2011). On the one hand, the complementary aspect of a sibling relationship involves differences in the distribution of power and knowledge (Howe et al., 2011). This "…natural mismatch between siblings' competencies provides an ideal context for the acquisition of skills" (as cited in Azmitia & Hesser, 1993). The complementary aspect of the sibling relationship provides children with rich experiences that expose them to advanced knowledge from their sibling. Specifically, knowledge from one sibling is shared with the other contributing to a greater understanding of a given concept or procedure. Thus, children's social understanding appears to set the stage for more successful teaching (Ziv & Frye, 2004). On the other hand, the reciprocal nature of a sibling relationship is characterized by more equal interactions. This is evident in siblings' similar levels of experience, knowledge, and power (Howe et al., 2011). This aspect of the sibling relationship makes information available within each sibling's zone of proximal development. Due to their unique experiences, older siblings may hold information that will be within their younger

sibling's zone of proximal development, but younger siblings may also contribute information relevant to their older siblings' development.

Age-related Differences in Teaching

Before three years of age younger siblings are limited in their verbal abilities. This weakness restricts their ability to teach their older sibling, but it does not suggest that older siblings do not learn from their younger sibling prior to the development of this ability. By age three and a half children display some of their earliest attempts to teach via verbal instruction. For the most part, this takes the form of providing direct instructions. From this age until about five years of age, children have been observed using a greater amount of verbal instruction during teaching (Strauss, Ziv, & Stein, 2002). Beyond this stage and in line with the emergence of theory of mind, children begin to take into account the learner's abilities and understanding. Around seven years of age children scaffold more effectively while teaching by adjusting their level of guidance to the needs of the learner (Wood, Wood, Ainsworth, & O'Malley, 1995). This demonstrates children's shift from a teacher-centered approach to a less controlling learner-centered approach. However, it is important to note that these findings concerning the developmental trajectory of teaching are based on investigations of children teaching their peers. While the literature is limited for sibling teaching, important similarities and differences have been found.

Azmitia and Hesser (1993) compared older siblings (9 years of age) teaching their younger siblings (7 years of age) versus when the older siblings' same-sexed peer (9 years of age) taught the same younger sibling. They found that learners were more actively involved in the teaching with their siblings than with the peers. In addition,

certain teaching strategies were found to be more prominent in the sibling relationship. Specifically, older siblings provided more explanation and positive feedback to their younger siblings during teaching than peers. Other teaching strategies were used equally by both siblings and peers (e.g., demonstration, direction). These results suggest that perhaps certain characteristics of children's teaching are similar across child-child relationships, while other aspects of teaching may be unique to the sibling relationship.

Sibling Teaching

The central goal of teaching is the transfer of knowledge. This typically follows the direction from a more knowledgeable individual to a less knowledgeable individual (Palinscar, 1998). There is a natural imbalance in knowledge that results from the birth order and age of the children that yields unique life experiences that each sibling encounters. Under the assumption that older siblings have acquired a greater number and variety of experiences, they are often considered the more knowledgeable partners. As such, research aimed at disentangling sibling teaching has primarily focused on the older sibling's ability to teach their younger sibling. From these investigations a number of age-related differences in sibling teaching have come to light.

On the whole, studies that have examined sibling teaching have followed an experimental design aimed at replicating a semi-naturalistic situation in which one sibling teaches the other. This typically involves a researcher teaching the older sibling a task such as how to construct a farm set or complete a puzzle. Following this instruction, the older sibling is then required to teach this same procedure to their younger sibling. For example, Howe et al. (2006) had an experimenter teach the older sibling ten block tasks ranging in difficulty. Following this instruction and successful completion of these tasks,

the older (ages 7-9) sibling was asked to teach their younger (ages 4-7) sibling the tasks. The authors were interested in the effects of the task difficulty on the children's teaching. Their hypothesis that older siblings would use a greater variety of teaching strategies during more difficult tasks was supported. Still, important variability was apparent in the strategies used by the older siblings during teaching despite task difficulty. The most recurrent teaching strategies used were feedback, scaffolding, and arrangement of materials, respectively. Interestingly, associations between these teaching strategies and the learner's response to the teaching were found. It appears as though the age of the teacher and the age of the learner are key variables. Younger siblings accept instruction more readily from an older firstborn sibling. Perhaps when the firstborn sibling is older it highlights the complementary feature of the sibling relationship, which supports the learner's acceptance of the teaching. This acceptance may be a key feature when examining the effectiveness of the teaching. In Howe et al.'s (2006) study the teacher was always the older sibling, thus it is possible that regardless of the age of the older sibling, younger siblings may be more accepting of the teaching. However, this was not addressed because the data only yielded information concerning the younger sibling in the learner role.

In contrast to the previous study, Klein et al. (2002) examined sibling teaching in younger dyads. The older siblings ranged from 5-6 years of age and the younger siblings ranged from 2-3 years of age. The older sibling was provided with the opportunity to explore the materials independently through play prior to the instructions. Following this, the experimenter demonstrated the correct way to play each game and informed the older sibling that they were going to give their younger sibling a chance to complete the tasks.

Importantly, the older siblings were instructed to teach or help only if they thought their sibling was having difficulty on their own. These instructions are quite different from the instructions outlined in other studies (e.g., Howe et al., 2006; Azmitia & Hesser, 1993), because it involved the learner struggling before the teacher engaged in teaching strategies. It is possible that the strategies used in the context of someone struggling independently, may be quite different than the strategies employed at the outset of teaching prior to experiencing difficulty.

Klein et al. (2002) examined a number of mediating behaviors (e.g., attention focusing, providing meaning) during teaching. These behaviors were positively correlated with the younger siblings' performance. Interestingly, prior to the teaching, the older siblings rated how well they thought their younger sibling would perform on the novel tasks. Ratings were positively related to the use of mediating behaviors; the higher the older sibling's perceived competence of their younger sibling, the more mediating behaviors the older sibling used. One surprising mediating variable that contributed to younger sibling's success on the tasks was negative feedback. The greater perceived competence, the more negative feedback the older siblings used, which appeared to help younger siblings complete the task.

Clearly, individual differences among older siblings' teaching strategies are dependent on the child's level of development and on an understanding of the learner's abilities. Klein et al. (2002) found that in general, there appeared to be a shift from a more teacher-centered approach to a more learner-centered approach to teaching as siblings develop. They found that older firstborn teachers used more comprehensive verbal instruction, and they also demonstrated the ability to scaffold according to the

learners' response to the teaching. These more sophisticated strategies are characteristic of learner-centered teaching approaches. Klein et al. (2002) found that younger firstborn teachers engage in demonstration more frequently than older teachers; while this may in part be due to their limited verbal abilities, this teaching strategy also ensures a certain degree of control over the teaching process, again, typical of a teacher-centered approach.

The developmental differences in teaching are evident not only in the specific teaching strategies used, but also in the level of control siblings maintain while teaching. The data reviewed concern the age of the firstborn sibling and their teaching abilities. However, given that the process of sibling teaching involves two children, it also seems necessary to examine younger siblings' teaching abilities. As mentioned earlier, by three years of age children display marked increases in their verbal abilities that lay the foundation for them to assume the teaching role. Accordingly, it is possible that younger siblings, three years of age or older, are able to teach their older sibling. Clearly, younger siblings' ability to teach their older siblings warrants investigation.

In a noteworthy study, Recchia et al. (2009) assigned the role of teacher to the younger sibling. This semi-naturalistic experimental design presented younger siblings with more power and knowledge than a natural setting would offer. Based on the literature reviewed, this appeared to be the first time that younger siblings' teaching strategies had been examined. The authors assigned 37 firstborns and 37 secondborns to the teacher role. Similar to other investigations, a research assistant taught the assigned teacher how to complete a task. Once these teachers were capable of completing the task, they were told to show their sibling how to complete the task. A clear pattern of results was obtained concerning the approach younger siblings used when teaching. The authors

found that younger siblings used more learner-centered strategies compared to their older siblings when teaching. Specifically, it appeared that when younger siblings were teaching the learner was more involved than when older siblings were teaching. This learner involvement also entailed allowing the learners to correct their mistakes.

Consistent with the developmental data examined earlier, older firstborn teachers appeared to focus less on controlling the teaching process than younger teachers. Although it was found that secondborn teachers permitted more learner involvement, this appeared to be moderated by the child's age; older secondborns limited their older siblings involvement in the task. It is possible that the older secondborns' age contributes to important experiences in the teaching role, which may foster a sense of competence while teaching that is similar to firstborn teachers. As such, older secondborn teachers may rely less on the input of their older sibling to guide their teaching.

Recchia et al.'s (2009) findings support the idea that younger siblings are capable of teaching. An initial examination of these interactions highlights that the teaching process appeared to be more cooperative as compared to firstborn teacher interactions. Closer examination reveals that older secondborn teachers demonstrated a shift towards maintaining more control over the teaching process. The fact that older siblings are so involved in the teaching as learners may reflect younger secondborn teachers' limited experience in the teaching role. Because older siblings primarily assume the teaching role, the younger siblings may be less familiar with this role (Brody, Stoneman, & MacKinnon, 1982).

In addition, if younger siblings perceive their older sibling as more knowledgeable, it is possible that younger siblings are more open to the inclusion of their

older siblings' input during teaching. Another reason for the acceptance of learner involvement from secondborn teachers could be due to an imbalance of power within the relationship. Specifically, older siblings may be involved in the teaching process in a more influential manner. Together these ideas highlight that it is important to consider the degree of learner involvement while examining sibling teaching. In addition, the multidimensional nature of the learner's involvement is exposed.

Gender Differences in Teaching

Some studies do not reveal any gender differences in teaching strategies used by siblings (e.g., Recchia et al., 2009), whereas others do (e.g., Howe et al., 2006; Klein et al., 2002). There are a variety of ways that gender can be examined concerning sibling teaching, however. Some investigations examined the makeup of sibling dyads. This considers whether there are two girls, two boys, or a boy and a girl in the sibling pair. These distinctions can reveal complex patterns concerning gender and the teaching strategies used during sibling teaching. Based on these compositions, some studies have found differences in sibling teaching depending on the gender of the teacher. For example, Howe et al. (2006) compared older brothers' and older sisters' teaching strategies and found that learners more readily accepted teaching from their older sisters. While this study supports the notion that perhaps the gender of the teacher impacts the learner's response to teaching, other investigations (Klein et al., 2002) indicate that the gender of both siblings is important. In essence, the composition of these relationships plays an instrumental role in sibling teaching.

Klein and colleagues (2002) examined gender differences in the use of mediating behaviors occurring during sibling teaching. Interestingly, the strongest effect was for

two brothers, older brothers used negative feedback and amplifying affect most often when teaching their younger brothers. These findings suggest that the gender of both the teacher and the learner may be important when considering the effectiveness of the teaching. As previously noted, this study found that negative feedback was positively related to the older siblings' ratings of their younger siblings' capability of completing a novel task. These evaluations require the older sibling to take into account the learner's abilities and perhaps even their level of understanding. Such evaluations then contribute to the teaching strategies used and subsequent learner involvement and success.

Social Understanding and Internal State Language

Social understanding plays an important role in children's comprehension of the concept of teaching and in their ability to teach. Social understanding includes the ability to make inferences about others' thoughts, emotions, intentions, and points of view (Dunn, 2007). Vygotsky (1978) argued that social interaction plays an essential role in children's cognitive development. Individual differences in social understanding gradually arise through children's unique experiences with others. These ideas originate from social constructivist and Vygotskian perspectives (Carpendale & Lewis, 2004), which place emphasis on children's experiences with others and examine how these can contribute to their social understanding. Importantly, a child's social understanding may serve as the foundation for structuring the teaching context to promote learning. One aspect of social understanding that has been emphasized in the literature is internal state language.

Internal state language is considered an indication of young children's social understanding, as it provides insight into their own emotions, thoughts, or beliefs, as well

as their understanding of others' internal states (Dunn, 2007). In addition, siblings' use of internal state language may also contribute to their development of social understanding. Specifically, a significant positive relationship between children's use of internal state language and the development of social understanding has been found (e.g., Dunn, Brown, & Beardsall, 1991; Hughes & Dunn, 1998; Dunn, 2002). For example, when a more advanced partner uses language that refers to internal states, they provide opportunities for children to learn these terms and to attach meaning to them based on their experiences. These experiences appear to set the stage for children's social understanding. Many studies in this area note the potential benefits of mothers' use of internal state language for children's social understanding (e.g., Moore, Furrow, Chiasson, & Patriquin, 1994; Taumoepeau & Ruffman, 2008). However, other research brings to light that children's interactions with their mothers become less frequent over time (Brown, Donelan-McCall, & Dunn, 1996). Thus, it is important to consider the effects of internal state language used in reciprocal relationships.

Hughes, Lecce, and Wilson (2007) investigated internal state language used by both siblings and friends. They found that children's use of internal state language was related to individual differences in ToM performance. Importantly, these differences were not attributable to children's verbal ability. Children engaged in more mental state talk with their siblings than with their friends, specifically when referring to their own feelings. Similarly, Dunn et al. (1991) demonstrated that children's talk about feelings during conversations with their friends and siblings was significantly related to their success on measures of false belief. Finally, Howe and Ross (1990) assessed children's use of internal state language via home observations of children with an older sibling

between 36 and 58 months and found that older siblings' references to internal states were positively correlated with children's social understanding.

Some researchers have attempted to disentangle the nature of the emergence of different types of internal state language. References to desires, beliefs, and thoughts become more frequent as children's age increases, respectively. In a longitudinal investigation Moore et al. (1994) found that children initially produced more desire terms than belief terms. Some authors argue that young children's physical limitations (e.g., limited mobility and dexterity) may require them to produce utterances aimed at meeting their desires and needs (Taumoepeau & Ruffman, 2008). As children develop and become more independent their references include ideas and thoughts beyond the immediate environment. This progression lays the foundation for children's social understanding and their use of internal state language during teaching, pretend play and conflict (Howe et al., 2011).

Exposure to internal state language from a sibling may facilitate the extraction of relevant information about others' perspectives. Ziv and Frye (2004) argue that the recognition of other's internal states can help a teacher determine which teaching behaviors would be most effective in a given situation. According to Strauss et al. (2002), a more complete understanding of teaching involves understanding how teaching affects others' minds. This information, based on siblings' greater shared experiences combined with knowledge of the learner's strengths and weaknesses, can direct children's teaching strategies. Thus, the language used while teaching may impact the learners' response to the teaching, ultimately influencing the learning that may or may not occur. This idea forms one of the questions for the current study.

The Current Study

Given the large gap in the literature concerning sibling teaching and in particular, the importance of considering both siblings' roles during teaching, the present research aimed to investigate similarities and differences between younger and older siblings' teaching in naturalistic contexts. Specifically, sequences of sibling teaching were identified within transcripts of sibling dyads (4-6 years of age) in their homes engaging in a wide variety of activities. These transcripts reflect the second time point of a larger longitudinal project (Ross, Filyer, Lollis, Perlman, & Martin, 1994). The sample included 39 dyads, each visited between six and eight times; sequences (n = 1078) of sibling teaching were identified on the transcripts (Della Porta, Howe, & Ross, 2011). The aim of this current investigation was to examine the frequency of both older and younger siblings' teaching in naturalistic contexts. Given that younger siblings were found to engage in teaching (Della Porta et al., 2011), another goal of the present study was to compare older and younger siblings' use of different teaching strategies. With regard to the literature suggesting a positive relationship between children's social understanding and their ability to teach effectively, children's use of internal state language used during teaching was also examined. Finally, the learner's response to teaching was investigated in relation to the teaching strategies, initiation of teaching, and internal state language.

Hypotheses

Hypothesis 1. Based on the literature (e.g., Howe et al., 2009) demonstrating that younger siblings are able to teach their older siblings and that children older than three years of age have the verbal capacity to engage in teaching (e.g., Strauss et al., 2002), it

was expected that younger siblings (4 years of age) would engage in teaching their older siblings (6 years of age) in naturalistic contexts and vice versa.

Hypothesis 2. Providing that Hypothesis 1 was supported, younger siblings were expected to engage in more direct instruction, demonstration and ignoring, as these strategies are less cognitively demanding. Whereas older siblings were expected to use more explanation, planning, clarification, positive feedback, and negative feedback compared to younger siblings due to the nature of these more complex strategies. For example, labeling an object with one word is less cognitively demanding than providing an explanation or offering feedback. In addition, other strategies such as clarification involve understanding of the other's perspectives. Because of the greater social understanding required when using such strategies, these were expected to be used more by older siblings.

Hypothesis 3. If support for the first hypothesis was found, then the current study aimed to investigate whether siblings use internal state language (a marker of social understanding) while engaging in naturalistic teaching. Given that social cognitive understanding has been found to be associated with children's teaching abilities (Strauss et al., 2002; Ziv & Frye, 2004), it was expected that older siblings would use more internal state language compared to younger siblings during teaching.

Hypothesis 4. Compared to younger siblings, older siblings ask more questions and overall appear to be more involved as learners when their younger siblings are teaching them (Recchia et al., 2009). Accordingly, it was expected that older siblings' would respond to their younger siblings' teaching by being actively involved, whereas,

younger siblings' were expected to comply with their older siblings' teaching, providing that Hypothesis 1 was supported.

Method

Participants

Thirty-nine sibling pairs from Caucasian, two-parent families were recruited from a city in Ontario. Data for this longitudinal study were collected at two time points for each family, except for one family who did not complete the follow-up home visit (Ross, et al., 1994). The present study examined data from the second time point, where the older siblings ranged from 5.4 to 7.0 years of age *(M* = 6.3 years) and younger siblings ranged from 3.8 to 4.8 years *(M* = 4.4 years). There was an approximate age difference of two years between the siblings. Sibling dyads' gender composition was counterbalanced with a relatively equal number of same-gendered (21) and mixed-gendered (18) pairs.

Procedure

As mentioned above, the data for this investigation were part of a larger project that aimed to examine parents' interventions in sibling conflicts. Six 90-minute sessions were completed within the families' home. This involved the observer dictating the siblings' interactions on a tape recorder. At the same time, a recording of the speech was made, which was later transcribed. To ensure that the observer was not involved in the family's interactions, the children were instructed not to interact with the observer. Children were free to engage in the activities and interactions of their choice. However, both children were required to be in the same room in order for observations to take place. The only restriction on children's activities was the use of electronic devices such

as television and video games. Prior to formal observations, rapport was established with the families via 20-minute reliability sessions.

Coding. The transcripts used in the present study had been previously coded for teaching sequences and teaching strategies (Della Porta et al., 2011). The present author was involved in the coding of the teaching strategies and was responsible for the coding of the internal state language within these teaching sequences for the present study.

Sibling teaching. In order to examine the strategies siblings use when teaching one another, two research assistants identified instances of sibling teaching within transcripts of children's interactions within their homes. They established reliability for the identification of teaching sequences within the transcripts, obtaining 67.3% agreement for 20% of the sample. This consisted of determining whether there was an intention of one child to teach the other and identifying the start and end line of the teaching sequence (see Appendix A).

Following the identification of the teaching sequences, one of the research assistants who was involved in the identification of the teaching sequences, and the current author coded the sequences of teaching using a coding scheme based on prior work (Howe et al., 2006). A copy of the coding scheme is found in Appendix A that includes definitions and examples of the codes.

A number of steps were involved in this coding: Identifying who was teaching, how the teaching was initiated, determining what type of knowledge was being taught, coding the presence or absence of a variety of teaching strategies and lastly, coding the degree of learner involvement in the teaching sequence. These will be explained in greater detail below.

Who is teaching? We identified who was teaching, either the younger sibling or the older sibling. If for some reason the siblings switched roles during the teaching, this was divided into two separate teaching sequences and then coded accordingly.

Initiation of teaching. We determined how the teaching was initiated. This included two possible codes: teacher initiated and learner initiated. On the one hand, teacher initiated sequences involved the teacher proposing to teach something to the learner or simply began engaging in teaching behaviors. On the other hand, learner requests for information from the teacher typically involved requesting information concerning how to do something or directly asking their sibling to teach them something

Teaching strategies. In the literature, a number of teaching strategies have been examined. In the present study eight types of teaching strategies were coded: direct instruction, demonstration, explanation, planning, questioning, and positive and negative feedback. All eight of these teaching strategies were coded within each teaching sequence as either present or absent. Direct instruction involved telling/suggesting the learner to do something in a direct way. This also included labeling, describing or sharing information, such as providing the name or label for an object (e.g., "this is batman"). While direct instruction is a verbal teaching strategy, demonstration can also be nonverbal (e.g., pointing). Demonstration essentially entailed showing the learner how to do something. Explanation is another important teaching strategy where teachers provided reasoning (e.g., "because if you don't put the top on it will spill"). This typically follows after something has occurred that requires explanation, such as "the balloon popped because there was too much air in it". Alternatively, a teacher may set out the steps in order to teach the learner something. This planning teaching strategy involved future tense

statements, for example, asking a question such as, “do you want me to show you which one is bigger?” and then following up by telling or showing which item is bigger. While this example is in the form of a question, it is structured in a manner to promote the teaching content. The teaching strategy of questioning in the form of clarification involves seeking information from the learner to ensure their understanding (e.g., “do you see how to do it? Ok?”). Another important aspect of teaching entails providing feedback. Two types of feedback are commonly used during teaching: positive feedback (e.g., praise, confirmation) and negative feedback (e.g., correction, criticism). Finally, ignore was coded when the learner would ask questions during teaching but the teacher would not respond to them. Based on these descriptions it is clear that the majority of teaching practices involved the use of language. Thus, the language children used while teaching is an important factor to consider when investigating the effectiveness of the teaching. This will be returned to later.

Learner involvement. A rating of the degree of learner involvement was determined based on their highest degree of involvement during the teaching sequence. First, Ignore/ No response included when the learner responded to the teaching with verbal or behavioral responses that were unrelated to the teaching, or simply did not respond to the teaching. Second, rejecting the teacher’s actions or statements was coded. Third, compliance was coded when the learner appeared to agree with the teaching, followed the teacher’s directions or repeated the teacher’s answer. Finally, active involvement was coded when the learner was clearly involved in the teaching process. It included asking questions or building on the teacher’s ideas or instructions. One of these four learner responses was coded for each teaching sequence.

Internal state language. The same teaching sequences that were identified and coded for teaching strategies were coded for internal state language. These sequences were coded line by line for each incidence of internal state language using an adapted version of the Howe and Recchia's (2008) coding scheme (see Appendix B for definitions and examples). The frequency of siblings' references to particular internal states was examined. This coding scheme assesses many aspects of references to internal states: goals, cognitions, emotions, and preferences. Contrary to the teaching strategy data, the internal state language was coded based on each occurrence of a particular reference, allowing for the possibility of frequencies greater than one, per sequence.

References to *goals* reflect an intended outcome. These included references to desires (e.g., want), obligations (e.g., need to), attempts (e.g., try to), and intentions (e.g., going to). *Cognitions* involved two subcategories: references to beliefs (e.g., I think, believe) and knowledge (e.g., I know, I have an idea). These statements are more subjective. These can be viewed as windows into the mind. In other words, these statements reflect awareness or consideration of their own and others' minds. References to positive (e.g., happy, proud) and negative (e.g., sad, mad) *emotions* were also coded. In addition, this category included references to unobservable physiological states (e.g., pain, hunger). References to *preferences* (e.g., I like, I hate, this is better) involved appraisal or evaluation on the part of the individual. This category also included references to traits (e.g., silly, smart, lazy), unlike other references to internal states, these reflected more permanent features of personality.

Reliability. Two individuals were trained to code children's teaching strategies and upon reaching an acceptable level of agreement, coding of the transcripts was

commenced. Reliability was systematically maintained by having coders independently assess every tenth teaching sequence and reach agreement concerning final codes. Therefore, inter-coder agreement was calculated based on 23% (n = 243 out of 1078) of the teaching sequences. Reliability was computed for each of the individual teaching codes, the *kappas* for the teaching variables were as follows: who was the teacher (.96), who initiated the teaching (.93), direct instruction (.80), demonstration (.91), explanation (.80), planning (.60), clarification (.75), positive feedback (.89), negative feedback (.84), ignore (.87) and learner response (.70). Similarly, following the same procedure, two coders examined siblings' references to internal states for 24% (n = 260 out of 1078) of the teaching sequences. The *kappas* for the internal state language variables were very good. Specifically, desires (1.0), obligations (.99), attempts (1.0), intentions (.99), beliefs (1.0), cognitions (.97), positive emotions (1.0), negative emotions (1.0), general emotions (1.0), physiological states (.99) and preferences (.99).

Results

Data Management and Reduction

Initially, the data were coded for teaching strategies and internal state language for each individual teaching sequence. Later, data were transformed by collapsing the teaching and the internal state language data by family as the unit of analysis. This ensured that data from certain families were not weighted more heavily than others based on more frequent teaching. This also offered the possibility of broadening the scope of the findings, rather than restricting them to particular naturalistic teaching conditions among siblings. The frequency of children's references to two categories of internal state language were extremely low. Specifically, Emotions (Positive M = .21, SD = .73;

Negative $M = .23$, $SD = .63$; General $M = .00$, $SD = .00$; Physiological States $M = .31$, $SD = .92$) and Preferences ($M = .31$, $SD = .66$). Given that neither of these variables were theoretically relevant for sibling teaching (Ziv & Frye, 2004), they were not examined further. In addition, there was one family for which the younger sibling did not engage in any teaching, as such comparisons between older and younger siblings' teaching would not have been possible for this family. Thus, this family was excluded from subsequent analyses. Accordingly, all analyses were conducted with a sample size consisting of 38 families. Given that older and younger siblings' ages were significantly positively related ($r = .82$, $p < .01$), an average of the siblings' ages within each dyad was determined; this dyadic age was used when controlling for age during subsequent correlational analyses.

Descriptive Statistics

First, descriptive statistics concerning the frequency of older and younger siblings' naturalistic teaching are available in Table 1(all tables are available following the Results section). Second, the frequencies of older siblings' internal state language, teaching sequences, who initiated teaching and learner response, can be found in Table 2. Finally, descriptive statistics concerning the frequency of the younger siblings' variables are located in Table 3.

These tables primarily present raw data in order to gain a clear picture of the actual occurrence of these variables. Proportion scores were used for all analyses in order to account for differences in the frequency of younger siblings' teaching sequences and the frequency of older siblings' teaching sequences per family. As such, one column (i.e., *M* proportion of sequences) offers proportional data necessary for interpreting the raw data meaningfully. For example, the mean for older siblings' references to goals is 6.32.

While the mean provides important information concerning older siblings' average across teaching sequences, it does not take into account the number of teaching sequences comparable per family. Therefore, it is also important to consider the mean proportion of sequences, indicating that older siblings referenced goals 26% of the time during teaching. This information allows for a more complete interpretation of the data.

Subsequent tables include proportion scores in order to make appropriate comparisons and generalizations. Analyses included a number of Pearson's correlations, *t*-tests, and a series of repeated measures ANOVAs. The following results will be presented beginning with age and gender effects, followed by results pertaining to each hypothesis, concluding with findings from a few exploratory analyses.

Age and Gender Effects

First, Pearson correlations were computed to determine whether each sibling's age was associated with their references to internal state language, teaching strategies, who initiated the teaching, and the learner's response to teaching. The older siblings' age was not significantly related to any of the variables examined for older siblings (see Table 4). For younger siblings, significant negative associations were found between the younger siblings' age and their use of positive feedback. Thus, as the younger siblings' age increased, they were less likely to use positive feedback during teaching. In addition, a number of trends emerged concerning younger siblings' age. Specifically, younger siblings' age tended to be positively associated with their use of direct instruction. The younger siblings' age also tended to be associated with their older siblings' learner response to their teaching. In particular, younger siblings' age tended to be positively associated with older siblings' compliance during teaching, while it tended to be

negatively correlated with their lack of response to teaching. Given the relationship between the younger siblings' age and these variables, dyadic age was controlled for during subsequent correlational analyses.

Second, a series of independent-samples *t*-tests were employed to examine gender effects concerning children's use of internal state language, teaching strategies, who initiated teaching, and learner response. Out of 64 independent samples *t*-tests, only two significant findings emerged, moreover, given that gender effects were not the focus of the current investigation, gender was not considered further.

Hypothesis 1: Do Siblings Engage in Naturalistic Teaching?

Descriptive analyses were conducted to determine the frequency of younger and older sibling teaching. The data supported the hypothesis predicting that younger siblings would engage in teaching their older siblings in naturalistic contexts and vice versa. Specifically, the data reveal that 249 out of the 1078 (23.1%) sibling teaching sequences involved the younger sibling teaching their older sibling. This finding provided an adequate sample in order to test the subsequent hypotheses, which involved comparing younger and older siblings' use of different teaching strategies, internal state language and the learner's response to teaching.

Hypothesis 2: Comparing Younger and Older Siblings' Use of Teaching Strategies

In order to examine whether younger and older siblings differ in their use of various teaching strategies, a 2 (i.e., older or younger sibling teacher) x 8 (i.e. direct instruction, demonstration, explanation, planning, clarification, positive feedback, negative feedback or ignore) repeated measures Analysis of Variance (ANOVA) was conducted. Because family was the unit of analysis, each sibling was considered one of

the repeated measures. It was expected that younger siblings would engage in more direct instruction, demonstration and ignoring, whereas older siblings were expected to use more explanation, planning, clarification, positive feedback, and negative feedback compared to younger siblings. This hypothesis was partially supported, a main effect of child (i.e., differences existed between older and younger sibling teachers) $F(1, 37) = 17.43$, $p < .001$, and teaching strategy (i.e., indicating differences in children's use of different teaching strategies) $F(7, 31) = 149.30$, $p < .001$, in addition to an interaction between child and teaching strategy $F(7, 31) = 2.51$, $p < .05$ was found (see Figure 1). Pairwise comparisons (Bonferroni) reveal that older siblings used significantly more demonstration, positive feedback and negative feedback compared to younger siblings during teaching (see Table 5).

Hypothesis 3: Comparing Younger and Older Siblings' Internal State Language

To determine whether siblings differed significantly in their use of internal state language, a 2 (i.e., older or younger sibling teacher) x 2 (i.e., references to goals or cognitions) ANOVA was employed. While it was expected that older siblings would use more internal state language when teaching compared to younger siblings, this was not supported by the data. However, a significant main effect for internal state language was found $F(1, 37) = 19.67$, $p < .001$, indicating that, regardless of who was teaching, both siblings referenced significantly more goals ($M = .25$, $SD = .03$) than cognitions ($M = .11$, $SD = .02$) when teaching.

Hypothesis 4: Comparing Younger and Older Siblings' Learner Response

The purpose of these analyses was to compare younger and older sibling's learner responses to teaching. Older siblings' were expected to be actively involved when their

younger siblings were teaching them, whereas, younger siblings' were expected to comply with their older siblings' teaching. As described above, a repeated measures 2 (i.e., older or younger sibling teacher) x 4 (i.e., no response, reject, comply or active involvement) ANOVA was used to test whether the learner's response (i.e., no response, reject, comply, or active involvement) was significantly different when older or younger siblings were teaching. Contrary to predictions, a main effect of teacher was not found. However, a main effect of learner response was found, $F(3,111) = 17.91$, $p < .001$. Overall, children rejected teaching more than they were involved. Specifically, the no response code ($M = .38$, $SD = .03$) was significantly greater than children's rejection ($M = .12$, $SD = .01$) and active involvement ($M = .23$, $SD = .02$) during teaching. In addition, learners rejected teaching significantly less than they complied ($M = .28$, $SD = .02$) and were actively involved during teaching. Finally, the mean difference between compliance and active involvement was not significant.

Exploratory Analyses

Exploratory analyses were conducted to determine whether older and younger siblings differ in the initiation of naturalistic teaching. A 2 (i.e., older or younger sibling teacher) x 2 (i.e., teacher initiated or learner initiated) repeated measures ANOVA yielded a significant main effect of who initiated the teaching $F(1,37) = 105.85$, $p < .001$. Overall, it appears that most naturalistic teaching between siblings was teacher initiated ($M = .72$, $SD = .02$) compared to learner initiated ($M = .28$, $SD = .02$), irrespective of whether the older sibling or the younger sibling was teaching.

Finally, a series of Pearson correlations were employed to examine whether any relationships existed between the learner's response to teaching and (a) internal state

language, (b) teaching strategies, and (c) who initiated the teaching (see Table 6). These results indicate a significant positive relationship between older siblings' references to cognitions and younger siblings' active involvement. Thus, in families where older siblings reference significantly more cognitions during teaching, younger siblings are likely to be actively involved in the teaching. However, younger siblings' references to cognitions were not significantly related to older siblings' active involvement. In addition, a significant positive correlation was found between younger siblings' use of planning and older sibling's active involvement, yet this was not the case for older siblings' use of planning and younger sibling's active involvement.

Table 1

Descriptive Statistics for Teaching Sequences (n = 39)

Variable	Minimum	Maximum	*M*	*SD*
O: Teaching sequences	3	82	21.28	15.56
Y: Teaching sequences	0	22	6.38	0.89

Note. O = Older sibling and Y = Younger sibling.

Table 2

Descriptive Statistics for Older Siblings' Internal State Language, Teaching Strategies, Who Initiated Teaching, and Learner Response (n = 38)

Variable	Older Sibling				
	Min	Max	*M*	*SD*	*M* proportion of sequences
Internal State Language					
Goals	0	38	6.32	7.66	0.26
Cognitions	0	27	2.11	4.57	0.12
Teaching Strategies					
Direct Instruction	3	74	18.00	14.51	0.84
Demonstration	0	46	9.34	9.09	0.42
Explain	0	14	3.13	3.47	0.13
Plan	0	14	2.21	2.76	0.09
Clarify	0	11	1.63	2.64	0.06
Positive Feedback	0	18	2.13	3.22	0.09
Negative Feedback	1	24	5.71	5.02	0.27
Ignore	0	7	1.55	1.66	0.08
Initiation of Teaching					
Teacher Initiated	2	62	15.68	12.18	0.74
Learner Initiated	1	20	5.21	4.50	0.26
Learner Response					
No Response	1	21	6.76	5.35	0.33
Reject	0	8	2.03	1.87	0.10
Comply	0	28	6.50	5.90	0.30
Active Involvement	0	29	5.61	5.49	0.26

Table 3

Descriptive Statistics for Younger Siblings' Internal State Language, Teaching Strategies, Who Initiated Teaching, and Learner Response (n = 38)

Variable	Younger Sibling				
	Min	Max	*M*	*SD*	*M* proportion of sequences
Internal State Language					
Goals	0	24	2.87	4.5	0.22
Cognitions	0	4	0.68	1.04	0.09
Teaching Strategies					
Direct Instruction	0	21	5.66	4.58	0.83
Demonstration	0	12	2.21	2.72	0.28
Explain	0	4	0.79	1.12	0.11
Plan	0	8	0.89	1.66	0.10
Clarify	0	2	0.24	.59	0.04
Positive Feedback	0	3	0.32	.74	0.04
Negative Feedback	0	6	1.21	1.60	0.16
Ignore	0	3	0.29	.65	0.05
Initiation of Teaching					
Teacher Initiated	0	18	4.74	4.25	0.69
Learner Initiated	0	5	1.82	1.57	0.31
Learner Response					
No Response	0	9	2.42	1.75	0.47
Reject	0	4	1.05	1.25	0.11
Comply	0	10	1.82	2.26	0.23
Active Involvement	0	8	1.26	1.54	0.19

Table 4

Pearson Correlation Results for Age Effects for Older and Younger Siblings' Internal State Language, Teaching Strategies, Who Initiated Teaching, and Learner Response (n = 38)

Variable	Older Sibling Age	Younger Sibling Age
Internal State Language		
Goals	0.13	0.14
Cognitions	0.16	-0.10
Teaching Strategies		
Direct Instruction	-0.03	0.30†
Demonstration	-0.02	0.14
Explain	-0.03	-0.02
Plan	-0.24	-0.25
Clarify	-0.23	0.18
Positive Feedback	0.05	-0.43**
Negative Feedback	0.09	0.03
Ignore	0.12	0.14
Initiation of Teaching		
Teacher Initiated	-0.13	-0.02
Learner Initiated	0.13	0.02
Learner Response		
No Response	-0.05	-0.29†
Reject	0.21	0.20
Comply	-0.18	0.27†
Active Involvement	0.08	-0.07

Note. $^{**}p < .01$, $^{\dagger}p < .10$.

Table 5

Repeated Measures ANOVA Results for Teaching Strategies (n = 38)

	Older Sibling		Younger Sibling		
Variable	*M*	*SD*	*M*	*SD*	*F*
Direct Instruction	0.84	0.02	0.83	0.04	0.06
Demonstration	0.42	0.03	0.28	0.04	8.59*
Explain	0.13	0.02	0.11	0.03	0.56
Plan	0.09	0.01	0.10	0.02	0.21
Clarify	0.06	0.01	0.04	0.02	1.96
Positive Feedback	0.09	0.01	0.04	0.02	4.72*
Negative Feedback	0.27	0.02	0.16	0.03	7.06*
Ignore	0.08	0.01	0.05	0.02	1.02

Note. * $p < .05$. *df* (1,37)

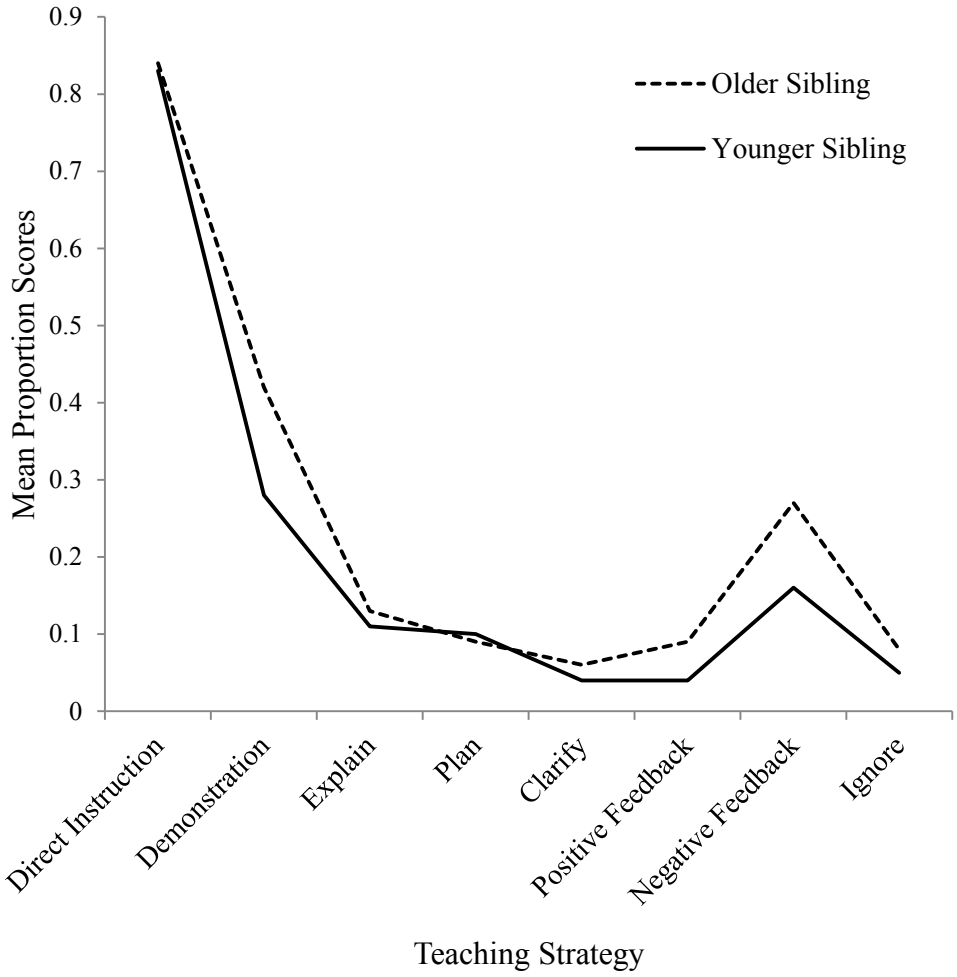
Table 6

Partial Correlation Results for Siblings' Internal State Language, Teaching Strategies, Who Initiated Teaching, and Learner Response Controlling for Dyadic Age (n = 38)

	Learner Response							
Variable	No Response		Reject		Comply		Active Involvement	
	O	Y	O	Y	O	Y	O	Y
Internal State Language								
Goals	-0.13	-0.15	-0.13	0.15	0.16	-0.14	0.09	0.25
Cognitions	-0.11	-0.03	-0.20	-0.11	0.08	-0.25	0.20	0.39*
Teaching Strategies								
Direct Inst.	0.16	-0.05	0.13	0.19	-0.24	0.07	-0.04	-0.15
Demonstration	-0.18	-0.03	-0.20	0.00	0.26	-0.01	0.11	0.03
Explain	-0.10	-0.11	0.25	-0.18	-0.02	-0.04	-0.05	0.31†
Plan	-0.25	-0.03	-0.13	-0.06	0.06	-0.02	0.32*	0.03
Clarify	-0.04	0.11	0.05	-0.29	-0.01	-0.02	0.02	0.08
Pos. Feedback	-0.04	-0.24	-0.18	0.10	0.04	0.13	0.13	0.09
Neg. Feedback	-0.11	-0.02	0.02	-0.17	-0.05	0.12	0.17	-0.03
Ignore	0.07	0.01	0.16	0.04	-0.12	-0.05	-0.04	-0.01
Initiation of Teaching								
Teacher Init.	0.15	0.03	0.08	-0.13	-0.34*	0.04	0.11	0.01

Note. O = Older sibling and Y = Younger sibling. * $p < .05$, † $p < .10$.
Sibling teaching variables correspond to the *opposite* siblings' learner response (e.g., Younger siblings' references to goals correlated with older siblings' no response = -.13; older siblings' references to goals correlated with younger siblings' no response = -.15).

Figure 1. Interaction between Teacher and Teaching Strategy



Discussion

Overall, the purpose of the present study was to compare older and younger siblings during naturalistic teaching on measures of teaching strategies, initiation of teaching, the learner's response to teaching, and internal state language. First, age and gender effects are briefly discussed. Second, an overall comparison of older and younger siblings' teaching in naturalistic contexts will be examined. Support from earlier work in addition to valuable qualitative data from the current study will be discussed in order to make appropriate conclusions and generalizations from the data. Third, the learner response to teaching will be examined within the context of sibling teaching. Fourth, the limitations of the current study will be reviewed. In conclusion, possible future directions and the implications of the current study will be discussed.

Age and Gender Effects

The current study examined the relationship between the siblings' ages and their use of internal state language, teaching strategies, initiation of teaching, and learner response. In contrast to Klein and colleagues (2002), findings from the current investigation indicate that the age of the older sibling was not significantly related to any of these variables. These findings may be attributable to the limited range of the older siblings' age in the current investigation. Although no significant age effects were found for older siblings, younger siblings' age was significantly negatively related to their use of positive feedback. This finding is counterintuitive, given that positive feedback is considered a more sophisticated teaching strategy, it would have been expected to increase in frequency with age. For example, Howe et al. (in press) found that older teachers were in fact more encouraging while teaching. The subsequent results only

approached significance, however they are important to consider in relation to previous findings. Specifically, younger siblings' use of direct instruction tended to increase with age. This pattern of findings replicates a pattern found in older siblings by Klein et al. (2002), whereby older siblings (5-6 years) were found to use more complete verbal instructions. Overall, children appear to use more verbal instructions when teaching as their age increases. Finally, as younger siblings' age increased older siblings tended to ignore (i.e., no response) less often and comply more with their teaching. Perhaps as younger siblings' age increase, older siblings regard them as a more viable source of information and as such are more likely to pay attention to and accept their teaching.

Similar to Recchia et al. (2009), no gender differences were found in teaching strategies. The lack of relationship between gender and the different teaching strategies suggests that boys and girls teach their siblings in a similar manner. This finding was also true with regard to children's use of internal state language, initiation of teaching, and the learner's response to teaching.

Naturalistic Sibling Teaching

First, it is important to recognize that the present study demonstrates that siblings do engage in naturalistic teaching. Second, whether the role of teacher is assigned (e.g., Recchia et al., 2009) or whether natural occurrences in which the younger sibling engages in teaching are observed, it is clear that younger siblings are capable of teaching their older siblings. One implication of this pattern of findings is that younger siblings should be considered when examining sibling's influence on each other's cognitive development.

The primary goal of the current investigation was to illuminate differences that may be apparent in siblings' use of different teaching strategies, initiation of teaching, learner response, and internal state language in naturalistic teaching contexts. While some differences do emerge, overall it appears that younger siblings teach similarly to older siblings. To begin, differences between older and younger siblings' teaching will be discussed, followed by similarities between older and younger siblings' teaching.

Comparing younger and older siblings' teaching. One central finding of the current investigation is that older siblings were observed using a greater repertoire of teaching strategies compared to younger siblings. This finding parallels earlier work (e.g., Howe et al., 2006), which also found greater variability in older siblings' teaching strategies. While it was expected that younger siblings would engage in more direct instruction, demonstration and ignoring than older siblings when teaching, this was not supported by the data. In fact, it was older siblings who used significantly more demonstration compared to younger siblings. Interestingly, most studies have reported younger siblings using greater amounts of demonstration during teaching (e.g., Howe & Recchia, 2005). This type of teaching behavior has been presumed to be a more basic strategy since it can be used by children with less advanced verbal skills. However, given the present findings, perhaps demonstration is a more sophisticated teaching strategy. The finding that older siblings used significantly more positive and negative feedback compared to younger siblings is in accordance with the reasoning previously described. While these comparisons bring to light important differences that emerge between older and younger siblings' use of different teaching strategies, other findings suggest that younger siblings use certain strategies similarly to older siblings. Younger siblings'

teaching skills appear to be related to their level of cognitive development, which is comparable to their older siblings between the ages of three and seven.

Howe et al. (2006) reported that feedback was the most frequently used strategy amongst the children in their investigation, followed by scaffolding, and then the arrangement of materials. A very different picture is portrayed by the data from the current study. Specifically, the most recurrent teaching strategies in the present study were direct instruction, demonstration, and negative feedback, respectively. This was true for both older and younger siblings, however older siblings used these strategies proportionately more than younger siblings. These differences in findings could be due to the fact that the ages of the teachers were not comparable between the two studies. Specifically, the older siblings in the Howe and colleagues (2006) study had a mean age of 8.2 years, as opposed to older siblings in the current investigation who had a mean age of 6.3 years.

While Howe et al. (in press) found that when teachers used demonstration in order to teach a task, learners were less involved, older siblings' greater use of demonstration was not significantly related to the learner's level of involvement (i.e., no response) in the current study. Failure to replicate this finding could be related to the nature of the teaching context. Perhaps in a structured task with a particular objective and one set of materials required so as to accomplish this goal, demonstration does not leave room for the learner to be involved. Whereas in more naturalistic contexts, when the teacher uses demonstration it may not necessarily exclude the learner.

Considering the context of sibling teaching. Given the naturalistic nature of the data, there are myriad contexts that can be considered when examining the strategies

children employ during teaching. It is clear that the setting in which the teaching takes place may restrict the use of particular strategies while promoting others. Furthermore, certain contexts may define the learner's response to specific strategies. The following examples will be used to illustrate how the context of the teaching and the materials involved may play a role in the determination of whether the learner will be actively involved or not, given the teacher's use of demonstration. The numbers refer to the line number of a given transcript. This is followed by an (O) or a (Y) indicating who is speaking or performing a particular action.

Example 1.

610 (O) THIS IS THE LAST DAY OF SCHOOL NO SCHOOL
611 (O) PTS TO CALENDAR DATE
612 (Y) WHY?
613 (O) BECAUSE I'M OFF
614 (Y) ON THE LAST DAY OF SCHOOL, GO TO THE GYM
615 (Y) PTS TO NO. 4 ON CALENDAR
616 (O) NO THIS DAY WENT TO THE GYM
617 (O) PTS TO DIFFERENT DATE
618 (Y) THIS DAY WENT TO THE GYM THAT'S NOT THE ONE, THAT'S NOT THE ONE THAT WENT TO THE GYM
619 (Y) PTS TO DATE ON CALENDAR
620 (Y) THAT'S THE ONE THAT WENT TO THE GYM
621 (O) TODAY?, WED. WENT TO THE GYM PLAY SOME TOYS IN THE CLASSROOM
622 (O) PTS TO CALENDAR

Example 2.

182 (O) HERE, THESE ARE THE ENDS ---.
183 (O) (SHOWS HOW TO ZIP THE PURSE)
184 (Y) (WANTS TO HANG UP THE PURSE)

In the first example the older sibling is the teacher. First, this example illustrates the three most common strategies that children used while teaching, direct instruction (line 610), demonstration (line 611), and negative feedback (line 616). In addition, this example shows how the resources involved in a particular teaching context may influence the learner's involvement. In this case the children are sharing a calendar, and the demonstration entails pointing to squares, thus, this behavior does not require the child to

physically monopolize the material. As such, it leaves room for the learner to be involved verbally and physically. Alternatively, in the second example the older sibling is teaching their younger sibling how to zip up a purse. Importantly, there is only one purse and one zipper. In this case the teacher uses demonstration, and the learner does not respond to the teaching, similarly to findings described by Howe et al. (in press). Clearly the materials involved in teaching impact children's involvement in the teaching, but what if no materials are involved in teaching?

Example 3.

1168 (O) WHAT'S A DONKEY KICK?
1169 (Y) IT'S THIS
1170 (Y) (DOES A KICK)
1171 (O) (O LAUGHS)
1172 (O) (DOES A KICK AS Y DID)

This example shows that if teaching relates to how to perform an action, then the use of demonstration does not exclude the learner from being involved (e.g., trying to complete the action, asking questions about how to perform the action), but it can also support the success of the learner. Furthermore, Rogoff (1998) would argue that direct instruction and demonstration are essential to the process of learning. This mirrors findings by Howe et al. (in press) who found that involvement was related to later learner success. Importantly, in this example the learner requested information about how to perform the action and was actively involved in the teaching. Conversely, in the second example the teacher assumed their role and the learner was not involved in the teaching. While these examples suggest that a relationship may exist between learner involvement and who initiated the teaching (i.e., the learner or the teacher), this was not supported by the data.

Insight into active involvement. Exploratory analyses yielded two significant positive correlations relating to the learner's active involvement during teaching. First, older siblings' references to cognitions were significantly positively correlated with younger siblings' active involvement during teaching. Considering the alternative, that is, that younger siblings' references to cognitions did not relate to older siblings' involvement is interesting. Perhaps older siblings are simply more involved in teaching (e.g., Recchia et al., 2009), regardless of the language used by younger siblings, that is, whether younger siblings are referencing cognitions or not.

While younger siblings' references to internal states were not significantly related to their older siblings' involvement, their teaching strategies were, particularly, use of planning. The more often younger siblings used planning during teaching, the more likely that their older siblings were actively involved. Based on correlational data, the direction of the relation between younger siblings' use of planning and older siblings' active involvement cannot be determined. Thus, it is possible that the more that younger siblings' used planning, the more likely their older sibling was actively involved. However, it is equally possible that when older siblings are actively involved in the teaching, this requires younger siblings to plan during teaching. Reflection on what entailed planning in naturalistic sibling teaching offers insight into how this teaching strategy may be particularly useful for younger siblings. Of particular interest were future tense statements (e.g., "I'm going to show you how to build the tower"), which would enable younger siblings to gain control over the teaching when interacting with their older sibling.

Initiation of naturalistic sibling teaching. While it was expected that older siblings would engage in more teacher initiated learning and younger siblings would engage in more learner initiated teaching, this hypothesis was not supported. As teachers, both siblings initiated teaching more often than waiting for the learner to request information in order to teach. This finding offers insight into how children's knowledge may impact the dynamics of their sibling relationship. What is particularly interesting is that within the context of naturalistic sibling teaching, children appear to assume the role of teacher, regardless of the natural balance of power. Accordingly, both children are capable of contributing to their sibling's understanding of a given concept or procedure, thus making meaningful contributions to each other's social-cognitive development.

In 2009, Howe and Recchia assigned the role of teacher to the younger sibling. The authors argued that, in this experimental design, the natural balance of power was reversed. Alternatively, rather than assume that older siblings maintain power within the sibling relationship, perhaps power should be considered an influence that varies according to the context in which siblings are observed. For example, consider information power (Raven, Schwarzwald, & Koslowsky, 1998), the person who has access or knowledge of the pertinent information has the power in that given context. Future research should investigate whether younger siblings are aware of the natural balance of power between themselves and their sibling. In addition, it is important to explore the implications of knowing that younger siblings typically do not have the power but because they hold the relevant information, they momentarily assume a position of power in which they can assume the teacher role. While the children in the present study assumed the role of teacher, it does not necessarily mean that they did not

consider the learner in this process. For example, a child may not have asked their sibling for help, but if a sibling was struggling and they offered information to help them, this behavior would be considered as being responsive to the learner. Importantly, the teacher must take into account the perspective of the learner in order to fully appreciate teaching (Strauss, 2002).

Internal state language and teaching. Regarding children's social understanding, the current investigation demonstrated that children use internal state language when engaging in naturalistic sibling teaching. Furthermore, the fact that references to emotions were so infrequent suggests that children are able to determine which types of references are most appropriate within particular contexts. Importantly, no effect of teacher was found for children's use of internal state language. This finding contrasts with previous research (Jenkins et al., 2003), which found that older siblings use more internal state language than younger siblings. What is particularly noteworthy is that these two conflicting findings emerge from within the same sample of children. However, it is important to note that the results obtained for the Jenkin's et al. (2003) study pertain to the entire transcript of each visit to the children's homes, whereas in the present study, internal state language was only coded in the identified teaching sequences. Perhaps the context of teaching limited children's use of particular terms, such as references to emotions and preferences which could account for these differences. While no main effect of teacher was found, a main effect of internal state language emerged.

Within the context of naturalistic teaching, both older and younger siblings referenced significantly more to goals than to cognitions. The finding that younger

siblings referenced a similar number of internal state language terms compared to older siblings in the current investigation could also potentially be explained by the age of the children. It could be that the children in the present study, even the younger siblings, as young as 3.5 years, have acquired the language necessary to reference internal states. While Strauss (2002) argues that social understanding can improve children's ability to teach, other literature provides evidence that suggests that children's understanding better equips them to make decisions about what information to accept (Povinelli & deBois, 1992). These authors argue that children as young as 6-years-of-age are able to use linguistic clues to determine the certainty with which someone is providing information. This notion of certainty will be explored further in the future directions section of this thesis.

Considering the learner's response to teaching. As learners, sibling dyads in the current study exhibited similarities. More precisely, both siblings were most likely not to respond to teaching. This was followed by some level of involvement either in the form of complying to the teaching or being actively involved. Finally, neither sibling rejected teaching very often, which raises the question, what is different about rejecting teaching?

Considering the main effect of who initiated teaching, indicating that the majority of naturalistic teaching was teacher driven, it was not surprising that siblings' first response was in fact, not to respond to the teaching. In other words, during naturalistic teaching both siblings were likely not to respond to their siblings' attempts to teach them when they had not requested the information. Given that children were observed in their homes in naturalistic settings, it is possible that children's attention was focused on other

events in the environment such as another person in the room or an interesting toy, however it is also possible that children were aware of their sibling's attempts to teach and simply decided to continue with what they were doing or change the topic of conversation.

When children become involved in teaching (i.e., compliance or active involvement), findings from the current investigation indicated that one type of involvement cannot be expected to occur more often than another, because children's rates of compliance and active involvement did not differ significantly. This challenges previous research findings reporting differences in the amount of involvement demonstrated by older and younger siblings during teaching (e.g., Howe & Recchia, 2005; Recchia et al., 2009). Particularly, older sibling learners were found to be more involved in the teaching process with younger sibling teachers. Interestingly, Recchia et al. (2009) found that as the age of the younger sibling increased, older siblings included them in the process of teaching more often. Furthermore, the current study did not find an interaction between the teacher and learner response. In other words, older and younger siblings' did not differ in their levels of active involvement in the current study. It is possible that because the age gap was smaller in the current study, both children more readily involved one another while teaching.

Taken together, while Recchia et al. (2009) found the teaching process to be more cooperative in an experimental design, naturalistic sibling teaching, in which the age gap between the siblings was small, revealed that in both cases (i.e., older sibling as the teacher or younger sibling as the teacher) teaching appears to be a cooperative process. There was a rich exchange of information that took place between siblings that

undoubtedly involved both partners. These findings appear to be similar to Rogoff's (1998) notion of guided participation, in which the learner is considered a critical partner in teaching and learning. Finally, regardless of who was teaching, both siblings were least likely to reject teaching. When the children's cognitive abilities are considered, the certainty and the power necessary to actually challenge (i.e., reject) what the teacher is saying or doing, may be more difficult for young children. Certainly, this speculation requires further investigation.

In conclusion, siblings do engage in naturalistic teaching using a variety of teaching strategies and referencing appropriate types of internal state, which ultimately impacts their social-cognitive development. While older siblings used more demonstration and feedback compared to younger siblings, on other measures (e.g., who initiated teaching, learner response, internal state language) younger siblings were comparable to their older siblings. While the age gap between the children may play an important role in determining the effectiveness of certain teaching strategies, it also seems critical to examine the context of teaching when interpreting these findings.

Limitations

There are a number of possible limitations of the current study that must be addressed. One potential limitation is that the accuracy of the teaching was not considered. Given that the findings from the current investigation support the notion that siblings influence each other's' social-cognitive development, it would have been interesting to determine whether such naturalistic teaching does in fact support their development and not simply skew children's understanding. For example, in one teaching sequence one sibling asked the other where Huggies diapers come from and the child

responded that they came from Burger King. Given the nature of the data, and the fact that the data were not collected with the intention of studying sibling teaching, some detail is missing within the transcripts that would have allowed for the assessment of the accuracy of the teaching. It is clear that further investigation into the accuracy of the naturalistic sibling teaching is required.

The nature of the data presented other challenges as well. Specifically, given that the data were collected within the home, there were instances within the teaching sequences where a parent became involved or began talking with one or both children. This interrupted the natural progression of the sibling teaching for these sequences. For example, if siblings were engaged in teaching and a parent asked one sibling a question, this disruption was considered the end of the teaching sequence; as such the learner response to teaching in this case would have been no response.

Finally, the individual differences between families and within sibling dyads proved to be challenging during analysis of the data. On the one hand, the data in the present study were collapsed by family in order to generalize to multiple contexts. On the other hand, because the data were not analyzed sequence-by-sequence, meaningful predictions based on careful sequential analysis were not possible. In other words, the data were manipulated in the current investigation, which made certain types of research questions not possible to address. For example, it is also important to assess within a given context, when the learner is actively involved, do teachers use certain strategies more than others? Answers to these types of questions would offer the opportunity to make more predictive conclusions. Accordingly, what could be considered a strength of the current investigation was also a potential limitation.

Future Directions

This study offers unique insight into the natural occurrence of sibling teaching within the home. Given that this topic has not been extensively researched, there are many avenues that require further examination. With knowledge that siblings do engage in naturalistic teaching, it would be valuable to design a study in which children are visited within their homes and observed with the intention of examining their teaching. In addition, it would be important for observers to record information concerning the accuracy of the teaching as they are transcribing, as this contextual information was sometimes lost within the transcripts.

Additionally, a more comprehensive examination of the current data may provide more rich information. Specifically, with a more refined coding scheme for children's use of internal state language it would be possible to distinguish between the use of such language and their actual function within the context of teaching. For example, distinction between statements such as "I'm sure" or "I'm not sure" and "I know" versus "I don't know" may shed light on the intricacies of how this language is used during teaching and provide a better understanding into how use of such terms can impact children's social-cognitive development.

Finally, while the present study has explored the teaching strategies, who initiated the teaching, the learner's response to teaching in naturalistic contexts, and use of internal state language, context appears to play a crucial role in the learning that occurs within sibling teaching. Accordingly, the specific context of the teaching that occurs naturally between siblings should be measured when looking at these types of associations. Specifically, what is the subject of the teaching? Do the materials require physical

manipulation on the part of the teacher, the learner, or both individuals? Answers to questions of this nature may help with the interpretation of findings relating to sibling teaching.

Implications

First, by indicating that younger siblings engage in teaching their older siblings in naturalistic contexts this study builds on existing literature and contributes to our understanding of sibling teaching. Furthermore, this information can be used to better understand the role that siblings play for each other's cognitive development. These data stress the importance of the bidirectional nature of this relationship and help disentangle the complexity of the teacher-learner dyad. As such, this study also offers important implications for educators and program planning. It also implies that adults should not overlook younger siblings as important agents of knowledge transmission. Especially for sibling dyads in which the age gap is small, this could fuel initiatives to help children with homework, by using the medium of the sibling relationship to positively influence children's school experience and success.

Moreover, if younger siblings use internal state language when teaching and this is associated with more learner involvement, this could be used to develop tutoring programs and afterschool workshops where siblings help one another complete their homework. Future research may also identify intervention programs for children who display learning difficulties, focusing on inclusion of references to internal states in order to bridge the information between the known and unknown in a meaningful manner.

An opportunity for enhancing the learning that takes place between siblings in the family context should also be considered. Parents can model certain teaching strategies,

such as explaining or providing feedback; in addition, they can limit their level of involvement when they are observing their children engaging in teaching in attempts to promote these behaviors at home. Using internal state language and supporting children's social understanding may improve children's ability to engage in teaching with their siblings which could influence their teaching outside the home.

Conclusion

Taken together these data suggest that siblings provide each other with some of their earliest forms of teaching experiences with other children. The current study was the first to compare siblings teaching in naturalistic contexts. Consequently, it offers valuable contributions to the literature on sibling teaching. First, a detailed account of both the teacher and the learner's role during teaching adds to the literature which has primarily focused on teacher behaviors. Second, it accounts for both older siblings' ability to teach in addition to younger siblings' ability to teach, the latter of which has often been neglected.

The findings of the current investigation highlight that while some differences between older and younger siblings' use of different teaching strategies are apparent, children ultimately approach teaching in a similar manner and respond to teaching from their sibling similarly. Furthermore, it suggests that children are capable of using appropriate internal state language terms when engaging in teaching and that the use of this type of language may be particularly important when considering the level of involvement of the learner during teaching.

These findings underscore the importance of considering the context of teaching. In a given teaching context, both a teacher and a learner role must be filled. Findings

from the current investigation reveal that siblings are most likely to assume the role of teacher. A more qualitative analysis of the data offers unique insight into how the subject and materials involved in teaching can potentially impact the strategies children use when teaching their siblings. In turn, these strategies may prove to be more or less effective depending on the context.

Importantly, all the results obtained are restricted to the context of the sibling relationship, which offer a variety of shared experiences and affectively intense interactions that may also contribute to their teaching behaviors, which were not considered in the current investigation. Nevertheless, analysis of sibling teaching that occurs within the home may strengthen our understanding of the teaching that takes place between children, which can be used to better comprehend interactions outside the home. It will be important to evaluate the effectiveness of these strategies when children go beyond teaching their brothers and sisters.

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Appendix A: Teaching Coding Scheme

Waterloo Teaching Study Coding Scheme Version 9
January 2010

1) **When is teaching occurring?** Read transcripts and identify sequences of teaching directed to the sibling (ignore teaching that involves the parent). Teaching sequences must involve an intention by one child to teach the other. Sequences can begin with an explicit direct intention of teaching ("I'm going to teach you dance steps") or seem like a more indirect sharing of information or knowledge, but have the intention of teaching the learner (e.g., "Those are little pencils. That's the paper for the pencil."). Teaching can include a correction (e.g., OS points our error to YS). Conversations or general discussions that do not include an intention to teach would not be coded.

   Identifying the start of a teaching sequence: If the learner requests teaching (e.g., YS ask OS how to construct something) then teaching sequence starts at the learner request. Sometimes one child just starts to spontaneously teach the other child, so start on the first line of the spontaneous teaching.

   Teaching sequences may go on for a number of lines; start coding when teaching has clearly begun (e.g., request from learner or teacher clearly initiates). End the sequence when the topic changes or the teaching appears to have ended or the teacher checks to determine if learner has understood or the learner does not respond and there is no further evidence of teaching. Teaching sequences must be a minimum of 2 lines and in the case of very short examples must include at least the initiation of teaching and the response. For example, the OS may offer to teach ("do you want to learn how to build that?") coded as (3a) and the learner could ignore or reject (7-0 or 7-1) or the YS could request teaching (3b) and the OS could ignore/refuse (5i). Of course, the YS may say yes and then a lengthy sequence of teaching could follow.

   Sometimes there are off-topic (non-teaching) lines in the middle of a teaching sequence. If there are three or more consecutive off-topic lines, code the resumption of teaching as a new sequence. If there are one or two lines that are off topic or directed to a parent, but the sequence of teaching appears to continue after the off-topic lines (and is the same topic), continue to code as the same sequence. However, the 1-2 off topic lines should be deducted from the number of lines within the sequence.

   If OS starts to teach but in the middle the YS assumes the teaching role, then start this as a new sequence.

   What is not teaching? Helping the sibling (e.g., tying shoes) without verbal explanation, instruction, or physically showing is not considered teaching. Also, bossy behavior that directs the sibling is not teaching. Invoking house rules or teaching social conventions (e.g., say please) or morality is not coded as teaching. Negotiating play or making up rules for pretense. If the sequence is ambiguous and not clearly teaching, do not code. Also, other examples of nonteaching are giving

orders or just playing, asking episodic questions or information (e.g., what is the dog's name? Who's car is this?), and anything conversational.

Teaching is counted when episodic sequences can be transferred to other learning (e.g., balancing a truck without wheels = physical properties)
For Pretend/Make-up games: Random rules are not teaching, but showing the learner how to follow through with a certain action is teaching (verbally or physically).

2) **Who is teaching?**

O	Older sibling is teaching the younger sibling.
Y	Younger sibling is teaching the older sibling.

Note: If teacher switches during sequence, this should be coded as a different sequence. The switch of teaching role should be very clear, for example if the Learner starts to ask questions, this is probably not a switch of teacher.

3) Initiation of teaching?

OT	**Offers to Teach**	Teacher asks learner if they want to learn something (e.g., You wanna learn how to make an onion?)
LR	**Learner Request**	Learner requests information or how to do something or directly asks for teaching. Code as request for teaching only when directed towards teacher and not towards mother or father. If request is directed towards M/F and the teacher (O or Y) takes over code as "c", assumes teaching role. Request can also be implicit such as learner showing that they are having trouble with something.
AR	**Assumes Role**	Teacher just starts engaging in direct teaching or announces that he/she is teacher. (e.g., If learner makes a mistake and the teacher corrects the learner. "There's no "e" in baby bear". It can be very implicit.)

4) **Teaching Strategies:** Teachers can use a variety of strategies during a teaching sequence. Code if the following strategies are present in each teaching sequence, and then identify the line within the sequence. (Present = **Y**, Not Present = **N**)

DI	**Direct Instruction (commands)**	Telling/suggesting the learner to do something in a direct way. Can be verbal (e.g., "do this"; "stand here", "Blake! That goes there".) or physical (e.g., O moves Y into right position for dance step). Labeling/describing/sharing information: providing name or label for an object, etc. (e.g., "This is an H"; "Nanny, nanno, nan, grandma, granny, gran…There's a lot of names for grandmother."). Can be coded along with another code (e.g., "no (NF) "that's the bull" (DI))
DEM	**Demonstration**	Showing how to do something (e.g., T does actions for a dance step so L can see). Also, simply showing something Can be verbal or nonverbal (pointing)
EXP	**Explanation**	Justifying or explaining a reason why; often starts with "because," (e.g., "because it's a name for grandma"), "so that," ("put it on top so it won't fall over") or "to" when it means "in order to" ("squish those together to make them fit).
PL	**Planning**	Setting out the steps for the teaching. Future tense. (e.g., "I'm going to get you all lined up and I'm going to see who can do it good"; "Now, do this…"; "Here, I'll help you"; "You're the leader again"; "I'll show you"; "Do you know which one is the highest?" And then showing the other which is the highest.
CL	**Clarification (check understanding)**	The teacher makes sure that the learner understands. Clarifications may be in the form of questions, especially tag questions ("Ok?" or "Do you see how to do it?"). Asking for information so as to check understanding (e.g., "How much is 2 + 2?").
PF	**Positive Feedback**	Praise (e.g., "good"; "that's right"; "yup")
NF	**Negative Feedback**	Correction (e.g., "you don't turn, no, not like that"; "no"; "that's not the bull")
IGN	**Ignore**	Refusing teaching requests from the learner. Learner asks teacher how to do something and teacher does not respond or refuses to demonstrate. Do not code if the No response is just coded out of the blue or if there is no response to a general question (e.g., "where is my necklace"; "where is grandpa?")

5) **Learner response:** rating of degree of learner involvement in the teaching sequence. When the learner's involvement varies across the sequence, rate the highest degree of involvement (e.g., if initially the learner rejects the teacher's actions, but then passively complies, rate the Learner response as REJ).

NR	**Ignore/ No Response**	When response is unrelated to teaching or behavior is unclear whether it follows context (e.g., when coded as other action).
REJ	**Reject**	Learner rejects teacher's actions or statements (e.g., T instructs the L to "leave a space to put him on" and L replies "no")
COM	**Compliance**	Appears to agree with teaching, follows directions, repeats teacher's answer. (e.g., T asks question and L responds with yes/no)
AI	**Active Involvement**	Learner asks questions, extends or builds onto teacher's ideas/ instructions or clearly wants to be involved. (e.g., "but why will the balloon pop if it gets too full?"; "ya, two plus two is four and two plus three is five")

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Appendix B: Internal State Language Coding Scheme

Internal State Language Coding Scheme

Categories of Internal State Language:

1) **Goals**: References to desires, obligations, attempts, and intentions. These statements indicate an outcome that the actor is heading towards, either because of their wish to do so or a sense of need.

2) **Beliefs**: References to knowledge and thoughts. These references indicate the subjectivity of a statement (e.g., I *think* that the sky is blue) and present a contrast to hard and true facts about the world. They also aim to provide information about the extent and content of one's own or others' knowledge, or provide a marker to indicate one's level of certainty about the world (e.g. think vs. know).

3) **Emotions**: References to feelings (e.g. happy, sad, mad, scared, jealous, etc.), unobservable physiological states (e.g., pain, hunger, fatigue), or verbal references to obvious physical manifestations of internal emotional states (crying, laughing). Also includes references to fun or being sorry, or asking what's the matter/what's wrong (in reference to an emotional display).

4) **Traits (preferences and other)**: This category refers to more permanent mental or personality characteristics of people. Also includes preferences (e.g., "I like puppies"). Note that traits must be something that is not immediately observable (e.g. "he has a runny nose" is not a trait). Appraisals/Evaluations are also not necessarily coded as traits (e.g., "he is a good boy") unless they refer to personality characteristics (e.g., being lazy).

Coding Instructions:

First, read the teaching sequence identified within the transcript line by line identifying every instance of a reference to an internal state. Once an internal state term has been identified, indicate whether it is the older sibling or the younger sibling who made the reference. Code it using the appropriate abbreviations (see following tables).

Example:

Teaching Sequence Identified in Transcript	**ISL**
271 (O) KYLE, YOU **WANNA** LEARN HOW TO MAKE AN ONION? (FROM CONSTRUCTION PAPER)	O Gd
272 (Y) OK. I **KNOW** HOW TO MAKE AN ONION.	Y Bk
273 (O) THERE.	
274 (O) (SHOWS THE PIECE THAT SHE CUT OUT)	
275 (O) A RED ONION.	
276 (Y) (PLAYING WITH HIS TRUCK AND LEGO)	

GOALS	
Desires - Gd	Aim for Change my mind Desire Dying to Hope Hopefully Interested Looking for Need (as in want) PERSON cry for PERSON expect (another person) to Pray for Want, wanna Wish Would like Would love Would love to
Obligations - Go	Am expected to/expect someone to Got to Have to/ had to/having to/has to Make sure Must Need to Obliged to Ought to Should, better Supposed to
Attempts - Ga	Attempt Seems Try
Intentions - Gi	Accident Expect to Intend to Mean to Meant On purpose Plan to Shall Going to be Going to, gonna I`ll show you

COGNITIONS	
Beliefs – Bb	Believe Deserve Decide, as in “What do you think?” Fair, as in not fair Feel (“I feel that you…”) Guess I’ll bet Imagine Might (be) Not sure/(to be) sure Pretend, “I’m making believe”, real - as opposed to pretend, “once upon a time” Probably Promised Reason, as in no reason Suppose Think, thought Wonder Worry
Knowledge – Bk	Aware Confused, “mixed up” as in confused Figure out Forget, never mind Get it (“Do you get it?”) Idea It’s true Know/I don’t know Lying Memories Notice Remember Right, as in correct Understand, “I see” as in understand Wrong, as in incorrect * "I have no idea" = "I don't know" "What is your idea?" ="What do you think?" “you’re right”/”you’re wrong” “I mean a cow” – self-correcting

EMOTIONS	
Positive-Ep	Comforted Cozy Curious Enjoy Excited Feel (better/good/ok) Fun Funny (not applied to object) Glad Happy Laugh Pleased Proud Smile Surprised (happily), wow To love (a person) Yum
Negative-En	Afraid Angry Bored Crying Embarrassed Feel (bad/worse/awful/hurt) Hate (a person) Hurt (mentally) Jealous Lonely Mad Sad Scared Scream Sorry Surprised (in a bad way) Upset Yuck
General-Eg	For general emotion refs ex. "How did you feel when you did that?" "Are you alright?"; "What is the matter?" Surprised (when there is no indication of whether it is negative or positive)

Physiological states-Eph	Alive, living, dead Fatigue Feel (e.g. feel drops on me; feels cold) Hunger Laughing Pain (burn, hurt, ouch, ow, sting) Sick Tired

PREFERENCES	
Preferences-P	Better (as in choice) Don't care about something (lack of preference) Hate (something – not person) Like/dislike (e.g. I like puppies) Love (something, NOT person) Traits (e.g. being lazy, clumsy, silly, smart, stupid, sissy) "Do you mind?" "I don't feel like it anymore"