It's All Relative: Sibling and Parent Teaching in Early Childhood

Julia Fuoco

A Thesis

In

The Department

Of

Education

Presented in Partial Fulfillment of the Requirements

For the Degree of

Master of Arts (Child Studies) at

Concordia University

Montreal, Quebec Canada

January 2021

CONCORDIA UNIVERSITY

School of Graduate Studies

This is to certify that the thesis prepared

By: Julia Fuoco

Entitled: "It's All Relative: Sibling and Parent Teaching in Early Childhood"

and submitted in partial fulfillment of the requirements for the degree of

Master of Arts (Child Studies)

complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by the final examining committee

_____ Examiner
M. D'Amico

_____ Examiner
H. Recchia

_____ Supervisor
N. Howe

Approved by _____
S. Kennedy, Chair of Department, S. Kennedy

Feb. 18, 2021 _____
P. Sicotte, Dean of Faculty

ABSTRACT

It's All Relative: Sibling and Parent Teaching in Early Childhood

Julia Fuoco

Research investigating family teaching is limited, and the recent focus on teaching in naturalistic settings has examined sibling-directed teaching when parents do not take an active role. Additionally, the family teaching literature has been widely devoted to studying teaching strategies. Examining conceptual and procedural knowledge provides insight on the ways families co-construct meaning and scaffold learning. The goal of this study was to compare parents' and siblings' conceptual and procedural knowledge use during naturalistic teaching episodes in the home. Thirty-seven middle-class families from southwestern Ontario, Canada were observed over two years as they engaged in six 90-minute interaction sessions. The present study examined data from the second time point, when children were four and six years of age. Parental teaching sequences were identified; previously coded sibling teaching sequences were also employed. Parental and sibling teaching sequences were coded for conceptual subcategories (social conventional behavior; game discussions; discussions surrounding language, literacy, and math concepts; and explaining concepts) and procedural knowledge subcategories (game procedures; other procedures). Results demonstrated no significant differences between mothers and fathers in their conceptual and procedural teaching. However, parents taught proportionally more conceptual knowledge than siblings, and siblings taught proportionally more procedural knowledge compared to parents. Parents taught more social conventional behaviors, whereas siblings taught more language, literacy, and math concepts. Siblings also taught more other procedures than parents. Findings surrounding parents' and siblings' knowledge use, overall and

by subcategory, across context and initiation are further discussed in light of current theory about teaching.

Acknowledgements

I would like to express my deepest gratitude to my thesis supervisor, Dr. Nina Howe, whose mentorship and encouragement throughout my Master's studies have helped me surpass my goals and abilities in research and practice. I would also like to extend my profound appreciation to Nazila Tolooei, for her assistance with coding the data for my thesis project. I am grateful for the continued support from my lab mates, whose feedback has helped my project come to fruition; especially to Dr. Ryan Persram, for his support and assistance during data analysis. I also extend my gratitude to my committee members, Dr. Miranda D'Amico and Dr. Holly Recchia, for their positive feedback and encouragement. Finally, my achievements throughout my studies would not have been possible without the love and support of my dear family and friends; I am eternally grateful for my parents, brothers, my partner Joseph Del Corpo, and my dear friends in the Child Studies program, Teresa Pirro, Anita Jandaly, and Nazila Tolooei. Thank you for believing in me, motivating me, and being there for me every step of the way.

Table of Contents

List of Figures ……..viii

List of Tables …….....ix

Introduction ……1

Statement of the Problem ……1

Social Constructivist Theories of Teaching and Learning ……..2

Sibling Teaching Literature: An Overview……..5

The Sibling Relationship as a Unique Context for Teaching and Learning ……..5

Sibling-Directed Teaching ……..6

Semi-Structured Studies of Sibling Teaching ……6

Naturalistic Studies of Sibling Teaching …..……..……..9

Parent Teaching Literature: An Overview ……13

Comparisons Between Mothers and Fathers ……14

Comparisons Between Parents and Children ……17

Conveying Conceptual vs. Procedural Knowledge Through Teaching ……19

Rationale For the Current Study ...……21

The Present Study ……23

Method ……26

Participants ……26

Procedure ..……27

Measures and Coding ....……28

Interrater Reliability ..……30

Results ……31

Plan of Analyses ……...……31

Descriptive Analyses ……...……32

Preliminary Analyses ……32

Parents' and Siblings' Knowledge Use ……33

Parents' and Siblings' Knowledge Use by Initiation ……37

Parents' and Siblings' Knowledge Use by Context …..……38

Discussion ……47

Parents Teaching of Conceptual and Procedural Knowledge ……...47

Parents' vs. Siblings' Use of Conceptual and Procedural Knowledge……..48

Parents' vs. Siblings' Use of Knowledge Subcategories ……..50

Parents' vs. Siblings' Use of Knowledge by Initiation of Teaching.…….53

Parents' vs. Siblings' Use of Knowledge by Context……54

Limitations and Future Directions ……...55

Implications ……..56

Conclusion ……58

References ……59

Appendix A – Sibling and Parent Teaching Coding Scheme ……..…….66

Appendix B – Gender and Gender Composition Findings ……..….78

List of Figures

Figure 1. Parents' and Siblings' Knowledge Type Teaching Interaction …….45

Figure 2. Parents' and Siblings' Subcategory Interactions (Conceptual and Procedural) ……....46

List of Tables

Table 1. Descriptive Statistics for Teaching Frequency (Parents; Mother, Father; and Siblings; Older, Younger) …….……40

Table 2. Descriptive Statistics for Teaching across Context and Initiation ……...41

Table 3. Descriptive Statistics for Knowledge Type (Overall and by Subcategory) ……42

Table 4. Proportion Means and Standard Errors for the Main Effect of Conceptual Subcategory …….43

Table 5. Proportion Means and Standard Errors for the Interaction Between Teacher, Initiation, and Knowledge ……...……44

Introduction

Statement of the Problem

Children's early and close relationships are critical for navigating the social world (Bornstein, 2015; Dunn, 1983; Hartup, 1989). In particular, siblings play a large role in constructing one another's social and cognitive development (Azmitia & Hesser, 1993; Barr & Hayne, 2003; Carpendale & Lewis, 2015; Strauss & Ziv, 2012). Social constructivist theory posits that children co-construct their knowledge together (Daniels, 2014; LeBlanc & Bearison, 2004; Miller, 2014; Palincsar, 1998; Rogoff, 1998). Additionally, recent social constructivist theorists argue that teaching occurs naturally without explicit instruction (Strauss & Ziv, 2012; Strauss et al., 2002). Similarly, parents are children's first connections to various contexts that foster learning and development (Bornstein, 2015; Carpendale & Lewis, 2015; Cicirelli, 1975). Parents play an important role in scaffolding their children's learning, especially in the early stages of childhood (Daniels, 2014; Palincsar, 1998; Rogoff, 1998).

By a large degree, the literature on teaching has investigated parent-child and sibling-directed teaching separately. However, both relationships are unique contexts that provide insight about how teaching and learning develops in children in early childhood. Examining both types of teaching together could provide valuable insight on the ways in which siblings may internalize and redirect the types of teaching strategies they are exposed to from the first teachers in their lives. Additionally, much of the research on parent and sibling teaching has utilized a semi-structured methodology (Azmitia & Hesser, 1993; Cicirelli, 1975, 1976; McGillicuddy-DeLisi, 1988). Exploring a naturalistic environment could unveil the ways in which teaching takes place spontaneously in the family context (Abuhatoum et al., 2016; Strauss & Ziv, 2012; Strauss et al., 2002).

Teaching within the sibling relationship has been examined extensively with regard to teaching strategies, and particularly the types of teaching strategies that are used depending on who initiates a teaching sequence, as well as the age, birth order, and gender of a teacher (Abuhatoum et al., 2016; Howe et al., 2006; Howe et al., 2015). Similarly, teaching within the parent-child relationship has been deeply rooted in the types of teaching strategies mothers and fathers use (Farhat, 2019; Mclaughlin et al., 1980; Worden et al., 1987). Less attention has been paid to the types of knowledge (i.e., conceptual and procedural) teachers convey while teaching. Although siblings' teaching of conceptual and procedural knowledge was investigated (Howe et al., 2015; Howe, Adrien, et al., 2016), to the best of our knowledge, it has not been addressed when parents teach their children. Such types of knowledge may provide insight about the level of expertise a teacher may hold, which can help deepen our understanding about the influence of development on the types of knowledge one may convey while teaching (Hatano & Inagaki, 1986).

Therefore, the goal of this thesis was to compare sibling-directed and parent-directed teaching during naturalistic home observations. In particular, parents' and children's use of conceptual and procedural knowledge during teaching were analyzed, including the ways it may vary depending on the context of teaching and depending on who initiates a teaching sequence.

Social Constructivist Theories of Teaching and Learning

Social constructivism is based on the premise that learners collaboratively construct their knowledge together (Daniels, 2014; Miller, 2014; Palincsar, 1998; Rogoff, 1998). Within the social constructivist framework, the definition of teaching is divided into two parts: First, a teacher has the intent to transmit knowledge to another person, and second, a teacher has the goal to expand or fill the gaps in a learner's understanding (Bensalah et al., 2012; Howe et al., 2012;

Strauss et al., 2014; Strauss & Ziv, 2012; Strauss et al., 2002; Ziv & Frye, 2004). This action of filling gaps in one another's knowledge highlights the bidirectional nature of teaching, as both partners play a role in contributing to one another's learning experiences (LeBlanc & Bearison, 2004; Rogoff, 1998).

Early social constructivists, such as Piaget and Vygotsky, emphasized that differences in knowledge, rather than differences in authority or status, are critical for teaching (Abuhatoum et al., 2016). For instance, Piaget regarded the teaching process as reciprocal, where individuals work simultaneously through their thoughts and ideas to collectively learn a new concept (Palincsar, 1998; Rogoff, 1998). Thus, learners work alongside one another to assimilate (i.e., apply newfound knowledge to their existing knowledge) and accommodate new information (i.e., adjust to newly learned concepts using their existing experience; Miller, 2014).

Similarly, Vygotsky viewed teaching as reciprocal, and developed the genetic law of development, which emphasized that learners who work collaboratively benefit most in their learning experiences (Palincsar, 1998). Moreover, Vygotsky's concept of the zone of proximal development (ZPD) contributes to the importance of knowledge differences in teaching. The ZPD operates on the principle that a teacher scaffolds a learner's knowledge to bridge the gap between what the learner can and cannot yet accomplish alone (Daniels, 2014; LeBlanc & Bearison, 2004; Miller, 2014; Palincsar, 1998; Rogoff, 1998). From this background, more recent social constructivists, such as Rogoff (1998), developed the concept of guided participation, whereby adults break down difficult concepts into more manageable parts for children to understand. Guided participation operates on the principle that a knowledge gap exists between teacher and learner. Through guided participation, a learner takes ownership of his or her own learning by becoming actively involved in the learning process, the involvement

which in itself is structured by the teacher (Howe et al., 2012; Recchia et al., 2009; Segal et al., 2017). In this regard, despite the complementary nature of teacher-learner relationships, which is emphasized through knowledge differences, guided participation allows the interaction between teacher and learner to become more collaborative (LeBlanc & Bearison, 2004).

Social constructivists also argue that teaching is a cognitive ability that develops naturally in humans (Strauss et al., 2014; Strauss & Ziv, 2012; Straus et al., 2002; Ziv & Frye, 2004). For instance, teaching is an activity that is not explicitly taught (Abuhatoum et al., 2016; Strauss et al., 2014; Strauss & Ziv, 2012; Strauss et al., 2002; Ziv & Frye, 2004), but a skill that reliably becomes evident in children as young as 3 years of age and improves over time (Howe & Recchia, 2009). Additionally, teaching occurs spontaneously (Strauss & Ziv, 2012) and intentionally (Rogoff, 1998). To illustrate, successful teaching is contingent on theory of mind, a concept that refers to understanding a person's thoughts, feelings, and desires (Strauss & Ziv, 2012; Strauss et al., 2002). Teaching therefore involves the ability of the teacher to understand that a difference exists in their own and the learner's knowledge, a skill that is both innate and applied with intention (Howe et al., 2012; Strauss & Ziv, 2012; Rogoff, 1998; Strauss et al., 2002).

The concept of teaching as a natural cognition is widely teacher-focused, with particular attention paid to how one develops the ability to teach. As a result, Strauss and colleagues (2014) recently developed a more learner-centered approach to teaching, referred to as teaching as a natural pedagogy. This view proposes that children naturally possess the ability to teach and to be taught, and become attuned to teachers' ostensive communication (i.e., use of encouragement; Strauss et al., 2014). In this sense, young children trust that their teachers are knowledgeable and trustworthy sources for novel information (Strauss et al., 2014). Overall, the premises put forth

by social constructivist theory create a concept of teaching that is contingent on collaboration and active participation by both teacher and learner, thus stressing the importance of the agents in children's surrounding environment to help navigate the social world (Hartup, 1989), which will be addressed in the following sections on sibling- and parent-directed teaching.

Sibling Teaching Literature: An Overview

The Sibling Relationship as a Unique Context for Teaching and Learning. The sibling relationship is marked by a combination of reciprocal and complementary exchanges (Howe et al., 2019). Reciprocal exchanges include interactions that highlight a relatively equal status between both siblings in that both children in a dyad can influence the course of their exchanges in fairly equal ways. Siblings spend a long time interacting with one another, and these reciprocal exchanges, which become evident in play and conflict, allow siblings to create a long co-constructed history together (Dunn, 2015; Howe, 2011; Hartup, 1989; Howe et al., 2019; Howe et al., 2017; Howe et al., 2001). On the other hand, the sibling relationship is also complementary in nature, especially with regards to differences in knowledge or power. These disparities manifest themselves through age and birth order differences between siblings, and are primarily evident during contexts of teaching and learning (Dunn, 2015; Howe et al., 2011; Howe et al., 2019).

Siblings spend a great deal of time together during the early stages of childhood (Dunn, 1983). Throughout this time, siblings construct a shared history together, during which they become acquainted with one another's knowledge, abilities, and experiences, all of which contribute to their learning outcomes (Dunn, 1983, 2015; Hartup, 1989; Howe, Adrien, et al., 2016; Howe et al., 2006; Howe & Recchia, 2009). As a result, the sibling relationship is a

primary context for social, emotional, and cognitive development (Carpendale & Lewis, 2015; Dunn, 1983, 2015; Hinde, 1979; Howe et al., 2006; Howe et al., 2019).

Sibling-Directed Teaching. By and large, the literature on sibling teaching utilizes a semi-structured methodology, such as tasks involving explicit instruction about building or problem-solving (Azmitia & Hesser, 1993; Howe et al., 2006; Howe et al. 2019; Howe & Recchia, 2005, 2009; Howe et al., 2012; Klein et al., 2002; Klein et al., 2003; Recchia et al., 2009; Strauss et al., 2002). Recently however, naturalistic methodologies have received greater attention, particularly studies which observe siblings as they naturally interact in the home (Abramovitch et al., 1979; Abuhatoum et al., 2016; Barr & Hayne, 2003; Howe, Adrien, et al., 2016; Howe, Della Porta, et al., 2016; Howe et al., 2015; Maynard, 2002, 2004; Segal et al., 2017). Nevertheless, literature employing either methodology has revealed ground-breaking findings regarding the nature of siblings' teaching interactions, including the initiation of teaching, use of teaching strategies, and differences between teachers. There are several factors which make the sibling relationship unique in promoting learning and development, each of which have been a major focus in the semi-structured and naturalistic sibling teaching literature (Howe & Recchia, 2009): Age, birth order, and gender differences.

Semi-Structured Studies of Sibling Teaching. The literature examining semi-structured teaching between siblings has gathered evidence for a variety of factors and their effects on teaching and learning. In these studies, the typical paradigm is that the research assistant teaches one child, typically the older sibling, a specific task (e.g., puzzles, construction tasks) and then this child is instructed to teach the task to their younger sibling.

Teaching strategies and effects of task difficulty. Siblings' teaching strategies are of great focus in the sibling teaching literature, accompanied by the effects of task difficulty on the

chosen teaching strategies. For instance, Howe and colleagues (2006) indicated that, regardless of age, teachers employed more teaching strategies overall for block construction tasks that were more difficult, with greater emphasis on scaffolding, demonstration, and feedback compared to easier block construction tasks. Additionally, learners showed greater involvement during difficult tasks compared to easier tasks. These findings may highlight children's ability to understand where differences in their siblings' knowledge may be lacking (i.e., theory of mind, Strauss & Ziv, 2012; Strauss et al., 2002), thus allowing them to break down aspects of difficult tasks for their sibling to understand (Rogoff, 1998).

Researchers have also examined how teaching strategies vary depending on the type of task being taught. For example, using a sample of 63 sibling dyads, Howe and colleagues (2012) investigated how 6-year-old children's teaching strategies differed during teacher-directed (i.e., tractor building) and self-guided (i.e., puzzles) tasks with their 4-year-old siblings. The results indicated that teachers used instructions, and verbal, nonverbal, and physical demonstrations during teacher-directed tasks. On the other hand, during self-guided tasks, teachers opted for attention and encouragement. According to Howe and colleagues (2012), these findings suggest that 6-year-old children may be capable of taking a learner-centered approach to teaching, by adapting their teaching strategies according to the type of task their sibling is completing.

Age gap, gender, and learner response to teaching. Studies employing semi-structured methodology have also examined the effects of age gap, birth order, and learner response on teaching. Older siblings may have a developmental advantage for teaching their younger siblings, simply due to their prolonged experiences within their environment and presumably greater knowledge (Abuhatoum et al., 2016). This prolonged experience allows older siblings to tailor their language (Dunn, 1983) and teach in a way they believe their younger sibling will

understand the task instructions (Howe et al., 2006; Howe & Recchia, 2009). Several semi-structured studies have examined the role of learner response in sibling teaching (Howe et al., 2019; Howe & Recchia, 2005; Howe et al., 2006). One example comes from a study by Howe and colleagues (2006), who examined the effects of age differences on how learners respond to their older siblings' teaching. The authors administered block puzzles of varying levels of difficulty for 7- to 9-year-old children to teach their 4- to 7-year-old siblings. The findings indicated that older teachers utilized explanations, scaffolding, as well as corrective feedback more often compared to younger teachers. Additionally, younger learners typically requested and responded more positively to teaching compared to older learners. These findings may be attributed to the fact that older siblings have more advanced cognitive skills than their younger siblings, which may make them more capable of using sophisticated teaching strategies (Howe et al., 2006).

The literature regarding gender differences in sibling teaching is mixed (Howe & Recchia, 2009; Howe et al., 2012). Some authors report no gender differences in teaching between siblings (Azmitia & Hesser, 1993; Howe et al., 2012; Maynard, 2002; Recchia et al., 2009). Other authors have found gender differences, but there is a lack of consensus. To illustrate, a study by Howe and Recchia (2009), which examined the differences in teaching during a tractor-building task, revealed that sisters provided overall more positive feedback in comparison to brothers as they taught their siblings. Moreover, brothers were likely to provide more positive feedback toward brothers rather than their sisters. On the contrary, a study by Cicirelli (1976) on sibling teaching during a problem-solving task revealed that sisters provided more feedback to brothers and brothers provided more feedback to sisters. Overall, the findings

highlight the discrepancy in the literature, suggesting that research on gender roles in sibling teaching are not yet clear.

Naturalistic Studies of Sibling Teaching. The literature that utilizes naturalistic observations is considerably smaller compared to the literature that utilizes a semi-structured methodology. Studies employing naturalistic methodology afford opportunities to observe how children attain new socio-cognitive skills in real-life settings (Abuhatoum et al., 2016; Howe, Adrien, et al., 2016; Howe, Della Porta, et al., 2016; Howe et al., 2015).

Perhaps one of the most prevalent findings within the naturalistic literature pertains to the comparison of older and younger siblings' frequency of teaching. Much of the literature has found that older teachers typically assume the teaching role during naturalistic interactions (Abuhatoum et al., 2016; Howe, Adrien, et al., 2016; Howe, Della Porta, et al., 2016; Howe et al., 2015; Howe & Recchia, 2009; Segal et al., 2017). It may be that older siblings are naturally inclined to take on the role of the teacher because of their age and experience (Abuhatoum et al., 2016; Howe et al., 2015; Ziv & Frye, 2004). On the other hand, perhaps younger siblings more readily accept teaching from their older siblings because they recognize differences in each other's knowledge (Howe et al., 2006; Howe & Recchia, 2009). However, a recent shift in the literature examining younger siblings' roles in teaching demonstrates that, as they age, younger siblings become more involved in the teaching process (Howe, Della Porta, et al., 2016; Howe & Recchia, 2009; Segal et al., 2017). For example, younger siblings use similar teaching techniques (i.e., direct instruction and demonstration) as their older siblings when observed at the same age (i.e., when both siblings are age 4; Howe, Della Porta, et al., 2016).

Teaching initiation. A large focus in the naturalistic sibling teaching literature has examined the ways in which siblings initiate teaching naturalistically. For example, Abuhatoum

and colleagues (2016)[1] observed 39 sibling dyads in the home as they engaged in an activity of their choice (i.e., games), of which older siblings were 6 years of age and younger siblings were 4 years of age. The findings showed that when siblings initiate teaching, they did so by referring to their knowledge or by questioning their sibling's knowledge. Conversely, when siblings initiated by requesting teaching (i.e., taking on the role of the learner), they referred most often to their lack of knowledge (Abuhatoum et al., 2016). These results may emphasize young children's ability to perspective-take and understand where their sibling's knowledge may be abundant or lacking (Abuhatoum et al., 2016).

Similarly, a study by Segal and colleagues (2017)[1] examined the progression of initiation and teaching approaches using language and literacy concepts. The authors used the same sample of sibling dyads as Abuhatoum et al., (2016), but longitudinally at two time points (at ages 2 and 4 and 2 years later at ages 4 and 6). While older siblings taught more at both time points compared to their younger siblings, younger siblings' teaching did increase in frequency over time. Additionally, 4-year-olds labeled pictures in storybooks to teach literacy concepts to their 2-year-old siblings. However, two years later, at age 6, older siblings focused on concepts regarding spelling and writing. This shift in focus may reflect older siblings' ability to tailor their teaching to their younger sibling's knowledge and developmental level. This shift may also highlight the impact of experience (i.e., school-entry) on older siblings' teaching techniques. According to Segal and colleagues (2017) it may be that older siblings create an environment so that their younger siblings can become accustomed to learning language and literacy concepts, which increases their confidence in teaching those skills as they get older. Thus, this study may

[1] Based on the same dataset used in the present study.

emphasize that older siblings are not the sole actors in teaching, and that younger siblings do play an active role in the learning and teaching process.

Teaching strategies and learner responses. A large portion of the naturalistic sibling teaching literature has also been devoted to examining teaching strategies. Howe, Della Porta, and colleagues (2016)[2] observed 39 sibling dyads as they interacted in the home over two time points (2 and 4 years of age, and again at 4 and 6 years). The findings demonstrated that direct instruction as well as demonstration were the most common teaching strategies in which older and younger siblings engaged (Howe, Della Porta, et al., 2016). Although the choice of teaching strategies was comparable, analysis of teaching strategy when both siblings were 4 years of age indicated that older siblings used more varied teaching strategies (i.e., demonstrations, negative feedback, and planning) compared to younger siblings. According to Howe, Della Porta, and colleagues (2016), these results may be explained by first-born siblings' deepened understanding of what knowledge gaps their younger sibling may have, thus possibly allowing them to use more sophisticated teaching strategies to fill those gaps (e.g., Strauss & Ziv, 2012).

In the aforementioned study by Abuhatoum and colleagues (2016), which used the same data set to identify which sibling initiated teaching naturalistically, there was also a focus on teaching strategies employed by siblings aged 4 and 6 years. Similar to Howe, Della Porta, and colleagues' (2016) findings, the results revealed that both younger and older siblings used direct instruction as their primary teaching strategy. However, older teachers opted for demonstration strategies when learners expressed their lack of knowledge about how to complete a task. Taken together, Abuhatoum and colleagues (2016) suggest that older siblings' use of both direct

[2] Based on the same dataset used in the present study.

instruction and demonstration may highlight their ability to use a learner-centered approach in scaffolding their younger siblings' learning when tasks may be too difficult (e.g., Rogoff, 1998).

Learner responses have also been identified in the naturalistic sibling teaching literature. In particular, studying imitation between siblings has provided insight about the ways that siblings respond to one another's teaching in naturalistic settings. According to Dunn (1983), imitation serves the purpose of building rapport between siblings, and can be a powerful and useful learning tool (Barr & Hayne, 2003). Younger siblings typically use imitation to learn from their older siblings, and older siblings tend to respond positively to imitation (Abramovitch et al., 1979; Howe et al., 2017). This positive response suggests that older siblings may interpret their younger siblings' imitation as displaying interest in learning. As a result, imitation between siblings may be associated with positive socio-cognitive development, as rapport through imitation may allow siblings to negotiate more amicably during interactions together (Dunn, 1983).

Overall, the literature on sibling teaching has identified several similarities when siblings engage in semi-structured and naturalistic teaching. For instance, both semi-structured and naturalistic teaching studies have revealed that siblings use teaching strategies such as direct instruction and demonstration to scaffold each other's learning (Abuhatoum et al., 2016; Howe et al., 2006). Additionally, older siblings can adapt their language, teaching strategies, and approaches to teaching according to the type or level of difficulty of a task in which they engage with their younger sibling (Abuhatoum et al., 2016; Howe et al., 2006; Howe, Della Porta, et al., 2016; Howe et al., 2012; Segal et al., 2017). Finally, although older siblings typically assume the teaching role more often, younger siblings also play an active role in their teaching, through their level of involvement in teaching sessions and their response to teaching (Howe et al., 2006;

Howe, Della Porta, et al., 2016; Howe & Recchia, 2009). The goal of the following section is to compare and contrast parent-directed teaching, particularly between mothers and fathers, and parents and children.

Parent Teaching Literature: An Overview

Parents play a crucial role in their children's development. Parents are the primary agents who connect their children to the world around them, and are thus critical in fostering positive social, emotional, and cognitive development (Carpendale & Lewis, 2015; Cicirelli, 1976; Hartup, 1989). The complementary nature of the parent-child relationship is highlighted through parents' knowledge and experience, which contributes to their higher status or authority, and allows them to foster a positive learning experience for their children (Hartup, 1989).

Relationship theory posits that children develop within the context of their close and intimate relationships (Carpendale & Lewis, 2015; Dunn, 1983; Hartup, 1989; Hinde, 1979). In this regard, parents and children form deep, meaningful relationships in the early stages of a child's life. Furthermore, Bandura's social learning theory argues that children learn how to navigate the social world by observing their parents' behavior (Bornstein, 2015). According to social learning theory, parents are highly influential in transmitting their behaviors and belief systems to their children. In addition, Bowlby's attachment theory states that parents form meaningful attachments with their children (Dunn, 1983; Hartup, 1989). Those who form secure attachments create a foundation from which children can openly engage, cooperate, and explore the social world. Finally, family systems theory emphasizes how the asymmetrical or hierarchical nature of the parent-child relationship is crucial for safety and wellbeing in early childhood and allows children to become more autonomous over time (Bornstein, 2015).

Parents play a critical role in their children's early experiences with their surrounding environments (Cicirelli, 1975; Pérez-Granados & Callanan, 1997; Sénéchal & Le Fevre, 2002; Tamis-LeMonda & Rodriguez, 2009; Wordan et al., 1987). In particular, the home is a context where young children formally and informally take their first steps in learning how to communicate (Sénéchal & Le Fevre, 2002; Tamis-LeMonda & Rodriguez, 2009; Wordan et al., 1987). The literature on parent teaching supplements the sibling teaching literature, as it may shed light on the ways in which children learn particular teaching strategies from their parents (Diaz et al., 1991).

Comparisons Between Mothers and Fathers. Of particular interest in the parent teaching literature is the differences and similarities between mothers and fathers in their approaches to teaching, most of which have been examined using a semi-structured paradigm. A study by Mclaughlin and colleagues (1980) explored the ways in which parents communicate with their children while playing games. The authors chose a game for 24 parents to teach and play with their 5-year-old children. The findings showed that fathers engaged in discussions surrounding imperatives (i.e., making a request in the form of a command) with sons more than with daughters. Overall, fathers' approaches to communication were more controlling than mothers, whose use of communication revolved around suggestions and clarifying rules. These results may highlight the differences in parental approaches to teaching during game-play (McLaughlin et al., 1980).

Research on parent teaching has also investigated the differences in scaffolding between mothers and fathers. Pratt and colleagues (1988) analyzed 24 parents' interactions with their 3-year-old children in the home as they separately assisted their children in a block construction task and a storytelling task (where a parent helped a child recount a story they had read together).

The authors found comparable abilities in scaffolding amongst mothers and fathers. Overall, both mothers and fathers helped scaffold their children's learning during difficult tasks and stepped back when children grasped the concept, suggesting that there are not many differences in scaffolding abilities during teaching between mothers and fathers (Pratt et al., 1988).

Similarly, Worden and colleagues (1987) investigated the differences in parents' teaching strategies during literacy activities. The authors randomly assigned 20 children aged 3 to 4 years with their mother or father in a laboratory setting to complete interactive alphabet activities on a computer, followed by a storybook reading task. Overall, mothers and fathers employed similar teaching strategies throughout the tasks; direct instructions, such as asking the child to label letters and objects, were most frequent. The only differences between mothers and fathers were associated with consistency in teaching strategies throughout each task. For example, mothers showed greater consistency in the number of direct instructions, negative feedback, questions, and comments during the alphabet activities and the storybook reading task. On the other hand, fathers only showed consistency in direct instruction across both tasks. Taken together, these findings highlight the potential differences in parent teaching strategies with their children (Worden et al., 1987).

Additionally, a study by McGillicuddy-DeLisi (1988) examined parents' differences in teaching during a storytelling and paper-folding task. The author instructed 240 parents to read through a story and then construct a boat out of paper and analyzed parents' use of low-level demands (i.e., asking a child to label or observe an object) and high-level demands (i.e., asking a child to find alternative solutions to a task). The findings indicated differences in parents' use of high-level demand communication were observed only during the paper-folding activity. In particular, mothers communicated high-level demands more often with sons, and fathers did the

same with their daughters. This finding may communicate differences in expectations from parents' when they teach their children (McGillicuddy-DeLisi, 1988).

Recently, Farhat (2019)[3] examined the differences in mothers' and fathers' teaching during naturalistic home observations. In particular, 37 families were observed in the home while engaging in an activity of their choice during six 90-minute observation sessions, the same sample as previously used in the literature to study sibling teaching (e.g., Abuhatoum et al., 2016; Howe et al., 2015; Howe, Della Porta, et al., 2016). Farhat (2019) coded for the strategies mothers and fathers used during teaching sequences, as well as the contexts in which they taught their children. The findings revealed that mothers and fathers did not differ in their proportion of teaching. However, mothers and fathers both opted for direct instruction most often during the teaching sequences, but mothers used more explanations that did fathers. Moreover, parents also differed in teaching contexts. Specifically, mothers were more likely to teach during times of conflict, whereas fathers were more likely to teach during games. Overall, these results may suggest that mothers and fathers may take somewhat different approaches to teaching, both in context and style (Farhat, 2019).

In sum, the parent-directed teaching literature highlighted several similarities and differences in parent teaching approaches. For instance, mothers and fathers use scaffolding and direct instruction while teaching to a similar extent, but mothers tend to be more consistent in the use of their chosen teaching strategy (Farhat, 2019; Mclaughlin et al., 1980; Pratt et al., 1988; Worden et al., 1987). Additionally, mothers and fathers differ in their communication during teaching, particularly with regard to the communication of high-level demands with sons and

[3] Based on the same dataset used in the present study.

daughters, and with the use of imperative language (by fathers), and suggestive language (by mothers; McGillicuddy-DeLisi, 1988; Mclaughlin et al., 1980).

Comparisons Between Parents and Children. Preliminary research on parent teaching compared maternal and sibling roles in helping children solve problems. For example, Cicirelli (1975) divided 120 first-grade children into three groups: work alone, with their older sibling in the third or fourth grade, or with their mother on a problem-solving task involving identifying patterns to illuminate a board of lightbulbs. The older siblings and parents were instructed to assist the focal child as best as they could during a practice round, and then the child was left to do a set of the tasks alone. The results demonstrated that children performed best on the problem-solving task when assisted by an older sister or mother than when they worked alone. In particular, focal children with an older brother did not benefit in the same way as those who received help from a sister or mother. According to Cicirelli (1975), this finding may be associated with socialization processes, whereby maternal delegation of tasks was typically aimed toward daughters, thus potentially communicating girls' abilities to assist in teaching.

In addition, using the same sample, Cicirelli (1976) followed up with another study examining the differences in helper behavior while assisting on the problem-solving task. Overall, the findings revealed that mothers typically used explanation and feedback more often than siblings. Moreover, focal children responded more willingly and often sought out help from their mother than their sibling. Perhaps children understand or intuitively recognize the knowledge difference between themselves and their parents, and deem their parents to be more reliable compared to their siblings in certain cases (Cicirelli, 1976).

Early studies comparing parent and child teaching have also looked at the mediational techniques employed during semi-structured teaching tasks. For example, Klein and colleagues

(2002) examined the ways in which older siblings' mediation differed from parental mediation. Using a sample of 40 preschoolers, Klein and colleagues (2002) examined 5- and 6-year-old siblings' use of mediation techniques with their younger 2- to 3-year-old siblings during four games and puzzle tasks. Mediation techniques included focusing the younger sibling's attention, providing negative feedback, providing encouragement, and regulating their behavior (i.e., outlining the steps needed to solve the task). The results revealed that 5- and 6-year-olds typically launched into their teaching without pre-planning the way they were going to show their sibling how to solve the problem (i.e., by preparing materials in advance). Whereas parents typically engage in expansion (i.e., asking questions), older siblings most often regulated their younger siblings' behavior, suggesting that siblings may teach with the intent to complete the task at hand, rather than to equip their siblings for long-term problem-solving. However, the findings also showed that 6-year-old siblings used more mediation techniques compared to 5-year-olds, which may suggest that their repertoire of mediation techniques becomes more diverse with age (Klein et al., 2003).

Overall, the limited literature comparing parent-child teaching has outlined key areas where parents and children differ in their teaching. For example, the literature shows that mothers tend to scaffold and pre-plan their teaching more than children (Cicirelli, 1976; Klein et al., 2002). However, children benefit from help from older sisters and from siblings' use of mediation techniques for short-term problem-solving tasks (Cicirelli, 1975; Klein et al., 2003). In the present study, a further comparison of parent-child and sibling teaching will examine how these family members teach conceptual versus procedural knowledge. The goal of the next section is to examine the literature outlining the use of different types of knowledge during teaching.

Conveying Conceptual vs. Procedural Knowledge Through Teaching

Very few studies have investigated the types of knowledge conveyed during teaching. Whereas examining teaching strategies provides insight about the techniques or styles of teaching in which parents and siblings engage, studying types of knowledge allows researchers to understand the different kinds of information about concepts and procedures teachers convey during a teaching sequence (Howe, Adrien, et al., 2016). In this regard, understanding the types of information parents and children convey during teaching can deepen our understanding of teaching from a social constructivist standpoint; we can become familiar with the extent of one's knowledge that is being contributed during the collaborative teaching sequence (LeBlanc & Bearison, 2004; Rogoff, 1998). Additionally, we can begin to understand parents' and children's use of their knowledge to scaffold others' knowledge in more depth (Daniels, 2014; LeBlanc & Bearison, 2004; Miller, 2014; Palincsar, 1998; Rogoff, 1998). In essence, a teacher's conveyed knowledge can lend clues into how teachers establish shared meanings to convey information in a way that would allow a learner to understand a concept or to be able to complete a task (Howe et al., 2015).

Knowledge can be divided into several categories. From a curriculum standpoint, Bloom (1956) conceptualized knowledge as dimensional, with conceptual and procedural knowledge serving a critical importance for the learning process. Conceptual knowledge is defined as a person's knowledge about ideas that exist in the world, and his/her capacity to rationalize why they exist and function (Hatano & Inagaki, 1986; Howe et al., 2015). Conceptual knowledge includes concepts, labels, and general knowledge, which allow one to draw meaning about a familiar surrounding environment and apply that meaning in unfamiliar contexts, in order to develop a new understanding (Hatano & Inagaki, 1986; Howe et al., 2015). On the other hand,

procedural knowledge entails one's understanding of how to do something, and ability to carry out steps to put something together or complete a task (Hatano & Inagaki, 1986). Procedural knowledge includes one's application of strategies to complete step-by-step processes within a task, by physical demonstration, and/or discussion about how to do so (Howe et al., 2015). These two knowledge types have only been examined broadly from a research standpoint, and therefore warrant more detailed, structured analysis (Howe, Adrien, et al., 2016; Howe et al., 2015), particularly in terms of how often parents and siblings teach procedural and conceptual knowledge.

Although minimal attention has been paid to conceptual and procedural knowledge in the literature, two notable findings can be identified. One focus in the conceptual and procedural literature deals with initiation during teaching. For instance, Howe and colleagues (2015)[4] observed 39 sibling dyads in the home when children were 4 and 6 years of age while they engaged in an activity of their choice. When learners initiated the teaching sequence by requesting teaching, teachers conveyed conceptual knowledge, whereas when teachers initiated the teaching sequence, they more often conveyed procedural knowledge. According to Howe and colleagues (2015), these findings may highlight older siblings' developmental advantage in using their experience to fill the gaps in their younger siblings' knowledge (Dunn, 1983; Strauss & Ziv, 2012), and ultimately the bi-directional nature of the sibling relationship (LeBlanc & Bearison, 2004).

A second study by Howe, Adrien, and colleagues (2016)[4] examined siblings' use of conceptual and procedural knowledge when conveying topics about mathematics, naturalistically in the home. Using the same sample from their previous study, Howe, Adrien, and colleagues

[4] Based on the same dataset used in the present study.

(2016) identified the types of mathematical concepts discussed (i.e., numbers, measurements, geometry), knowledge conveyed, and the contexts in which siblings taught one another (i.e., pretend play, games with rules, play with toys). The findings revealed that siblings conveyed conceptual knowledge more often when discussing topics related to number. However, procedural knowledge was typically conveyed more often when topics of geometry were discussed. Additionally, siblings used more conceptual knowledge during contexts where they played games-with-rules, whereas procedural knowledge was used during contexts of play with toys. According to Howe, Adrien, and colleagues (2016), these results imply that children may be attuned to the nature of an activity or topic, such that more abstract mathematical concepts and contexts of play warrant conceptual information, whereas concrete topics and contexts warrant discussion regarding how to do something. Notably, this distinction in the sibling-directed teaching literature has not been examined for parents. Therefore, it would be worthwhile to examine parents' use of knowledge type to see how it may be similar or different from the ways that sibling use conceptual and procedural knowledge.

Rationale for the Current Study

At its current standpoint, the literature on sibling teaching has been deeply rooted in semi-structured methodology (e.g., Azmitia & Hesser, 1993; Howe et al., 2012; Klein et al., 2003; Strauss et al., 2002). Likewise, much of the literature on parent teaching has utilized teaching tasks in formal settings (Cicirelli, 1975, 1976; McGillicuddy-DeLisi, 1988; Mclaughlin et al., 1980; Pratt et al., 1988; Worden et al., 1987), and has paid minimal attention to the types of knowledge conveyed during teaching (Howe, Adrien, et al., 2016; Howe et al., 2015).

With its growing popularity, studies employing naturalistic methodology have unveiled new findings regarding initiation of sibling-directed teaching (Abuhatoum et al., 2016; Howe et

al., 2015; Segal et al., 2017), teaching strategies (Abuhatoum et al., 2016; Howe, Della Porta, et al., 2016) and cultural differences in teaching strategies (Maynard, 2002, 2004). In particular, the recent focus on teaching in naturalistic settings has helped researchers gain insight into the ways teaching happens spontaneously between siblings (Strauss & Ziv, 2012; Strauss et al., 2014; Strauss et al., 2002) in real-life settings (Abuhatoum et al., 2016; Howe, Adrien, et al., 2016; Howe, Della Porta, et al., 2016; Howe et al., 2015).

However, many naturalistic studies have opted to explore sibling-directed teaching when parents are not taking an active role during sibling teaching (Abramovitch et al., 1979; Abuhatoum et al., 2016; Barr & Hayne, 2003; Howe, Adrien, et al., 2016; Howe, Della Porta et al., 2016; Howe et al., 2015; Maynard, 2002, 2004; Segal et al., 2017). Parents undoubtedly play a role in children's early socialization process (Carpendale & Lewis, 2015; Cicirelli, 1976; Hartup, 1989). Therefore, analyzing parental contributions to teaching their children in naturalistic settings is a valuable addition to the existing literature examining the ways children become more proficient in teaching one another (Abuhatoum et al., 2016; Howe, Della Porta, et al., 2016; Segal et al., 2017).

In a similar vein, a large focus in the parent and sibling teaching literature has been paid to use of teaching strategies (Abuhatoum et al., 2016; Howe et al., 2006; Howe et al., 2015). Shifting the focus to conceptual and procedural knowledge can provide insight into the varying levels of expertise siblings and parents might convey during teaching (Hatano & Inagaki, 1986), and may further expand our understanding about how teachers utilize knowledge to co-construct meaning and scaffold learning during a teaching sequence (Daniels, 2014; Rogoff, 1998). Moreover, considering that conceptual and procedural knowledge have only been analyzed

broadly (Howe, Adrien, et al., 2016; Howe et al., 2015), it is worthwhile to refine these knowledge types into more specific sub-categories, to allow for more detailed analyses.

The Present Study

The goal of my thesis was to compare sibling-directed and parent-directed teaching as it occurred naturalistically in the home. Particular attention was paid to parents' and siblings' use of conceptual and procedural knowledge when they engage in teaching. According to Bornstein (2015), parents act as children's earliest models for children's socialization process. As a result, children may reference their earliest learning experiences with their parents as a guide to teaching their siblings. Alternatively, teaching appears to be a natural cognitive activity, as children are not explicitly taught to teach (Strauss et al., 2014; Ziv & Frye, 2004). Therefore, this thesis may provide further insight on the ways in which teaching and learning naturally occurs in the family context.

The aim of this thesis was to expand on the research conducted by Farhat (2019) and Howe and colleagues (2015), which both utilized the Waterloo dataset, to draw these comparisons between sibling and parent teaching. In their study, Howe and colleagues (2015) found that siblings who initiated teaching naturalistically used procedural knowledge, whereas siblings who requested teaching from their sibling were often taught conceptual knowledge. Given our understanding of children's use of conceptual and procedural knowledge during sibling-directed teaching, it was important to identify parents' use of conceptual and procedural knowledge to see if it differs from sibling-directed teaching.

The Waterloo data set consists of 39 families from southwestern Ontario (Ross et al.,1994). Families were observed longitudinally in a 2-year study in their homes during six 90-minute sessions, for a total of 9 hours of observation at each of the two time points. At the first

time point, younger and older siblings were 2 and 4 years of age, respectively. At the second time point, younger and older siblings were 4 and 6 years of age, respectively. For the purpose of this thesis, only the data from the second time point was analysed. In about 50% of the observation sessions, both parents were present in the home, and in the other half, only the mother but not the father was present. In the present study, only the sessions where both mothers and fathers were present were employed. Families were instructed to engage in an activity of their choice (excluding television and videogames), during which time they were coded for physical and verbal behaviors. The Waterloo data set was appropriate for the goal of this thesis, as it allowed for an analysis of the interactions that took place between siblings and both parents (Ross et al., 1994). Therefore, to compare sibling-directed and parent-directed teaching, three main research questions were addressed:

Research Question #1: To what extent do parents use conceptual or procedural knowledge when teaching their children? Furthermore, how do parents and siblings compare on their teaching of conceptual and procedural knowledge overall, and by subcategory (labels/definitions; categories/classifications; explaining concepts; general procedural skills; task-specific procedural techniques; see Appendix A for definitions and examples)?

Farhat (2019) found that mothers and fathers taught proportionally the same amount, but it was not known if they focused on conceptual and procedural knowledge to the same degree. Given that mothers expanded more on their teaching through use of explanations and clarifying rules than fathers (McLaughlin et al., 1980), mothers were expected to use more conceptual knowledge, whereas fathers were expected to use more procedural knowledge.

As this will be the first study to refine categories of conceptual and procedural knowledge into subcategories, no predictions were made about how parents and siblings would compare in their use of each knowledge type by subcategory.

Research Question #2: Does the type of knowledge conveyed by parents vary depending on who initiates the teaching sequence? Furthermore, how do parents and siblings compare on their use of conceptual and procedural knowledge depending on teaching initiation, overall, and by subcategory (Appendix A)?

In the sibling literature, Howe and colleagues' (2015) findings demonstrated that learners who requested teaching from their sibling were taught conceptual knowledge, whereas siblings who initiated teaching conveyed procedural knowledge. Given the trend in the sibling literature, which suggested that a developmental advantage can allow a teacher to fill in the gaps in a learner's knowledge (Dunn, 1983; Strauss & Ziv, 2012), it was predicted that when parents initiated a teaching sequence, they would also convey more procedural than conceptual knowledge to their children. On the other hand, considering McLaughlin and colleagues' (1980) finding in the parent teaching literature that fathers used more imperatives (directives in the form of commands) during games, whereas mothers used more suggestions and clarifying rules, it was predicted that, when a learner requested teaching, fathers would convey more procedural knowledge, whereas mothers would convey more conceptual knowledge. Finally, given the lack of literature dedicated to parent-child teaching, no predictions were made regarding the comparison between parents and siblings on teaching initiation.

Research Question #3: Does the use of conceptual and procedural knowledge vary depending on the context in which parents (mothers vs. fathers) and siblings (older vs. younger) teach one another? Farhat (2019) found that fathers taught more during game contexts, whereas

mothers taught more during times of conflict. Given the structural nature of games, it was hypothesized that fathers would use more procedural knowledge during game contexts. On the other hand, mediating conflict generally requires justification and reasoning, both of which are conceptual in nature (Ross et al., 1994). Thus, it was predicted that mothers to use more conceptual than procedural knowledge during contexts of conflict.

The Waterloo data set had not yet been utilized to explore the context in which siblings teach one another, although a number of contexts were coded in the original data collection, such as games-with-rules, conflict, pretense, and contingent activity (Ross et al., 1994). The specific context of sibling teaching during naturalistic settings has not been studied and was one of the goals of the present study. In the case for siblings, given previous findings regarding how older siblings typically scaffold their younger sibling's learning during tasks they perceive may be difficult (Abuhatoum et al., 2016; Howe et al., 2006; Howe, Della Porta, et al., 2016; Maynard, 2002), it was logical to predict that, like fathers, older siblings would teach more in contexts that are structured, such as games. Likewise, games are highly procedural in nature, and therefore older siblings were hypothesized to use more procedural than conceptual knowledge during this context. Similarly, considering Segal and colleagues' (2017) finding that younger siblings' teaching may increase over time due to the environment older siblings create to boost their confidence when teaching, younger siblings were predicted to teach in similar contexts as their older siblings. Therefore, younger siblings were hypothesized to also teach most often during games, and as a result, utilize procedural knowledge most often during this context.

Method

Participants

The Waterloo data set includes 39 White families from southwestern Ontario, Canada (Ross et al., 1994). Of the 39 families, 37 included sessions where both the mother and father were home during the observations. Given that one of the aims of this study was to examine both parents, only these 37 families were considered. Within these families, there were 20 same-sex sibling dyads (10 female, 10 male dyads), and 17 mixed-sex dyads (8 older female-younger male; 9 older male, younger female dyads). For the purpose of this study, observations from the second time point were examined. During the T2 observations, the younger siblings' mean age was 4.4 years (*SD* = .21), and the older siblings' mean age was 6.3 years (*SD* = .42). Additionally, parent ages ranged from 25 to 50 years, with mother's age at T2 averaging 34.48 years, and father's age averaging 36.6 years. Among the parents, 29% held a university degree, 15% held a community college degree, 41% held a high school diploma, and 15% did not hold a high school diploma. Ethics was obtained by the University of Waterloo for the original data collection (Ross et al., 1994), and by Concordia University for research for the current project.

Procedure

Observations were conducted in the family homes at a time convenient to the family. Prior to the official observation session, two research assistants (RAs) conducted a 20-minute warm-up or reliability observation session. These reliability sessions served the purpose of establishing interrater reliability between both RAs, and also allowed participants to become comfortable interacting in the presence of an observer. Throughout the observation sessions, families were instructed to engage in an activity of their choice (excluding television and videogames). Additionally, families were told to ignore the one RA, who observed behavior unobtrusively during the data collection sessions. During the actual observations, this RA coded 96 possible physical and verbal behaviors (e.g., hit, give) on one track of a dual track recorder,

while the second track recorded the ongoing language of the participants. The presence of the observer was assumed to have had little effect on the family members' interactions with one another, as contact was seldom made between the participants and observer throughout each session.

Measures and Coding

Teaching sequences for parent- and sibling-directed teaching were previously identified (Farhat, 2019; Howe et al., 2015). Start and end lines for each teaching sequence were identified in accordance with the presence of an intent to teach. For instance, the intent to teach may have presented itself explicitly (i.e., a direct instruction) or implicitly (i.e., a suggestion, correction, or reprimand with an accompanied explanation; Farhat 2019). Teaching sequences excluded conversations surrounding social conventions or rules.

Teaching Initiation. Each teaching sequence also previously coded for the initiation of a teaching sequence (see Appendix A). The following teaching initiations were considered: (1) a learner requested teaching; or (2) a teacher assumed the teaching role.

Context. A number of teaching contexts were previously outlined by Ross et al. (1994; see Appendix A). For the purpose of this project, the following contexts were considered: (1) conflict sequences were indicated when disagreement or incompatibility of behaviors between two people took place; (2) contingent activity sequences were indicated as any actions between two or more family members, which proceeded one another; and (3) game contexts were indicated when family members took part in games-with-rules or turn-taking during games. In the present study, the context during which the teaching sequences occurred were retrieved from the original coding transcripts (Ross et al., 1994).

Conceptual vs. Procedural Knowledge. Previous analyses in the sibling teaching data specified instances of conceptual and procedural knowledge (Howe et al., 2015). However, no such coding had been conducted for parent-teaching. Therefore, in the present study, instances of conceptual and procedural knowledge for parents were coded (see Appendix A) following from the coding conducted for the sibling teaching sequences. Each sequence received only one code: (1) conceptual; (2) procedural; or (3) conceptual and procedural.

When identifying conceptual knowledge sequences in the parent-teaching data, discussions about information or ideas about concepts, labels, and general knowledge were accounted for. More specifically, teaching sequences utilizing conceptual knowledge were classified if there was discussion or explanation about why various concepts or ideas exist and their function (Hatano & Inagaki, 1986; Howe et al., 2015). When identifying procedural knowledge, discussions or demonstrations about how to carry out steps of a task were outlined. In particular, procedural knowledge was coded when one demonstrated understanding or requested for help to carry out any type of procedure (Hatano & Inagaki, 1986; Howe et al., 2015). Notably, sequences of conceptual and procedural knowledge were not mutually exclusive. In this regard, a single teaching sequence may have included the presence of one or both conceptual and procedural knowledge.

Once all sequences for parent-teaching for conceptual and procedural knowledge were identified, subcategories of conceptual and procedural knowledge were coded for both parent- and sibling-directed teaching (Appendix A). Subcategories were established through qualitative analysis of themes that arose throughout the teaching sequences, which were then refined into distinct subcategories. Subcategorizing the types of knowledge allowed us to draw comparisons between specific types of knowledge parents and children used, and allowed us to identify in

what particular ways parents and siblings were similar or different in their use of each type of knowledge. During the coding process, each sequence received a subcode. Subcodes were mutually exclusive within their respective knowledge type. For instance, teaching sequences that were coded as conceptual received only one conceptual subcode. Likewise, teaching sequences that were procedural received only one procedural subcode. Teaching sequences that were both conceptual and procedural therefore received one conceptual and one procedural subcode.

Conceptual knowledge was divided into four subcategories: (1) social conventional behavior (e.g., discussions surrounding expected behavior, manners, etiquette, house rules, and safety); (2) game discussions (e.g., discussions surrounding the rules, purpose, or object of a game); (3) discussion regarding language/literacy/math concepts (e.g., providing or defining the name of an object or idea, or discussing mathematical concepts, such as numbers); and (4) explaining concepts (e.g., discussions and explanations surrounding troubleshooting or preventing problems related to concepts; discussion about why or how something works/is the way it is).

Procedural knowledge was divided into two distinct subcategories: (1) game procedures (e.g., demonstrating or discussing processes related to games and/or play materials); and (2) other procedures (e.g., demonstrating or discussing processes related to everyday activities, unrelated to games and/or play materials).

Interrater Reliability

Previous studies utilizing the Waterloo dataset obtained interrater reliability (*kappa*, *ps* < .001) for several variables, including the identification of teaching sequences for siblings (.96; Howe et al., 2015), parent-teaching initiation (.75; Farhat, 2019), sibling-teaching initiation (.93; Howe et al., 2015), context (.95; Ross et al., 1994), and knowledge type for sibling-directed

teaching (.74; Howe et al., 2015). For the purposes of interrater reliability, any *kappa* value above .75 is considered excellent, but a value between .60 and .75 is still acceptable (Fleiss, 1981).

For this study, interrater reliability was obtained for the coding process of conceptual and procedural knowledge, overall for parents, and by subcategory for parents and siblings. Specifically, 20% (*n* = 218/1061 parent and 90/449 sibling) of the teaching sequences were utilized to establish reliability between both coders. One coder remained unfamiliar about the goals of the study. If both coders agreed on the type of knowledge or subcategory, it was marked as an agreement. If there was a discrepancy in the code for knowledge type between coders, it was marked as a disagreement, and then was reconciled on an agreed code by discussion. Prior to coding for reliability, coders underwent extensive training to identify knowledge types and subcategories. Coders also met frequently throughout the coding process to address and resolve questions about coding and identification of codes. The kappas for each sequence identification were as follows (all *ps* < .001): (a) parent conceptual and procedural knowledge = .93; (b) parent subcategory knowledge code = .95; (c) sibling subcategory knowledge code = .96.

Results

Plan of Analyses

Results were analyzed using repeated measures analysis of variance (ANOVA) with family as the unit of analysis. We established statistical significance (*p*-value) prior to analysis at $p < .05$. Effect size was reported using eta-squares for significant effects. The Greenhouse-Geisser correction was used to adjust the degrees of freedom if sphericity was violated. Additionally, when a result was statistically significant, a post-hoc comparison was conducted, and Bonferroni corrections were applied.

Proportion scores were created to control for the number of times families taught one another. For instance, to account for the number of times mothers used conceptual knowledge, the raw score of mothers' conceptual knowledge was divided by the sum of mothers' use of conceptual plus procedural knowledge. The independent variables in the analyses included (a) knowledge type (conceptual, procedural), (b) subcategory of conceptual (i.e., social conventional, game discussions, language/literacy/math concepts, explaining concepts) or procedural knowledge (i.e., game procedures, other procedures), (c) initiation (assumes role, learner request), (d) context (conflict, contingent activity, game), (e) parent (mother, father), and (f) sibling (older, younger). The dependent variables in the analyses included the proportion of teaching (for parents and siblings).

Descriptive Analyses

The analyses include results from 1,510 total teaching sequences (1,061 for parents; 449 for siblings) that were identified for the 37 families (range = 0 - 123 for parents, and 0 - 42 for siblings). The descriptive statistics for parent and sibling teaching frequency are reported in Table 1. The descriptive statistics for teaching across contexts are found in Table 2. Finally, the descriptive statistics for knowledge type (overall, and by subcategory) are reported in Table 3. The tables are found at the end of the results section.

Preliminary Analyses

Gender and Gender Composition. A series of one-way ANOVAS were conducted to analyze effects of gender and gender composition (i.e., same-sex and mixed-sex dyads) for initiation, context, and knowledge type. Results revealed only nine significant effects ($p < 0.05$) for gender and gender composition out of the 225 analyses conducted (4%). Given the marginal

effects, the next analyses did not control for gender and gender composition. Refer to Appendix B for the nine findings associated with gender and gender composition.

Parents' and Siblings' Knowledge Use

Parents' Conceptual and Procedural Teaching. A 2 parents (mother, father) x 2 knowledge (conceptual, procedural) repeated measures ANOVA was conducted to test the proportions of parental use of conceptual and procedural knowledge. The results revealed a main effect of knowledge, $F(1, 32) = 470.85$, $p < .001$, $\eta_p^2 = .94$. Overall, conceptual knowledge ($M = .89$, $SE = .02$) was taught more than procedural knowledge ($M = .11$, $SE = .02$). No significant interaction was found between parents and knowledge use, $F(1, 32) = .01$, $p = .92$ $\eta_p^2 = .00$. Fathers ($M = .89$, $SE = .02$) and mothers ($M = .89$, $SE = .03$) did not differ significantly in their use of conceptual knowledge. Fathers ($M = .11$, $SE = .02$) and mothers ($M = .11$, $SE = .03$) also did not differ in their use of procedural knowledge. Thus, our first hypothesis was not supported.

Parents' Conceptual Subcategory Teaching. A 2 parent (mother, father) x 4 conceptual subcategories (social conventions, game discussions, language/literacy/math concepts, explaining concepts) repeated-measures ANOVA was conducted to test the differences in parents' use of conceptual subcategories. The was no significant main effect of parents, $F(1, 32) = .01$, $p = .92$, $\eta_p^2 = .00$. Fathers ($M = .22$, $SE = .01$) and mothers ($M = .22$, $SE = .01$) did not significantly differ in their proportions of teaching. However, findings showed a main effect of subcategory, $F(1.7, 55.04) = 12.11$, $p < .001$, $\eta_p^2 = .28$. Pairwise comparisons revealed that social conventions ($M = .40$, $SE = .04$) were taught significantly more than language/literacy/math concepts ($M = .12$, $SE = .02$), and explaining concepts ($M = .12$, $SE = .02$), but not significantly more than game discussions ($M = .24$, $SE = .04$). Additionally, there were no significant differences between teaching game discussions, language/literacy/math

concepts, and explaining concepts. No significant interaction was evident between parents and conceptual subcategory teaching, $F(1.83, 58.55) = 2.24$, $p = .12$, $\eta_p^2 = .07$.

Parents' Procedural Subcategory Teaching. To test for significant differences in parents' teaching of procedural subcategories, a 2 parents (mother, father) x 2 procedural subcategories (games, other) repeated measures ANOVA was employed. Findings demonstrated no significant main effect for parents, $F(1, 32) = .01$, $p = .92$, $\eta_p^2 = .00$. Fathers ($M = .06$, $SE = .01$) and mothers ($M = .05$, $SE = .01$) did not differ significantly in their proportions of teaching procedural knowledge. However, the results revealed a significant main effect of procedural subcategory, $F(1, 32) = 7.2$, $p = .01$, $\eta_p^2 = .18$. Pairwise comparisons revealed that game procedures ($M = .08$, $SE = .02$) were taught significantly more than other procedures ($M = .03$, $SE = .008$). There was no significant interaction between parents and procedural subcategory, $F(1, 32) = .001$, $p = .98$ $\eta_p^2 = .00$. Fathers ($M = .08$, $SE = .02$) and mothers ($M = .08$, $SE = .02$) did not differ significantly in their use of game procedures. Fathers ($M = .03$, $SE = .01$) and mothers ($M = .02$, $SE = .01$) also did not differ significantly in their use of other procedures.

Siblings' Conceptual and Procedural Teaching. Howe and colleagues' (2015) previously analyzed differences in siblings' conceptual and procedural teaching and reported more conceptual knowledge when a learner requested teaching, and more procedural teaching when teachers initiated a teaching sequence. However, previous analyses did not account for subcategories of conceptual and procedural knowledge, nor did they account for birth order.

Siblings' Conceptual Subcategory Teaching. A 2 sibling birth order (younger, older) x 4 conceptual subcategories (social conventions, game discussions, language/literacy/math concepts, explaining concepts) repeated measures ANOVA was employed to test for differences in siblings' proportions of conceptual subcategory teaching. No significant main effects were

shown for siblings, $F(1, 30) = 2.74$, $p = .11$, $\eta_p^2 = .08$. Older ($M = .19$, $SE = .009$) and younger ($M = .21$, $SE = .01$) siblings did not differ significantly in their proportions of teaching. Findings demonstrated a significant main effect of conceptual subcategory, $F(1.8, 53.69) = 18.85$, $p < .001$, $\eta_p^2 = .39$. Pairwise comparisons revealed that language/literacy/math concepts ($M = .46$, $SE = .06$) were taught significantly more than all other conceptual subcategories. Additionally, social conventions ($M = .002$, $SE = .002$) were taught significantly less compared to all other conceptual subcategories. There were no significant differences between game discussions ($M = .21$, $SE = .04$) and explaining concepts ($M = .12$, $SE = .04$). Results demonstrated no significant interaction between sibling birth order and conceptual subcategory $F(1.6, 47.78) = 16.63$, $p = .21$, $\eta_p^2 = .05$.

Siblings' Procedural Subcategory Teaching. A 2 sibling birth order (older, younger) x 2 procedural subcategories (games, other) repeated measures ANOVA was employed to test the differences in siblings' proportions of procedural subcategory teaching. The results revealed no significant main effects for sibling birth order, $F(1, 30) = 2.74$, $p = .11$, $\eta_p^2 = .08$. Older ($M = .13$, $SE = .02$) and younger ($M = .08$, $SE = .03$) siblings did not differ significantly in their proportion of teaching procedural knowledge. Moreover, no significant main effect was found for procedural subcategory, $F(1, 30) = 2.65$, $p = .11$, $\eta_p^2 = .08$. Game procedures ($M = .08$, $SE = .02$) and other procedures ($M = .13$, $SE = .03$) did not differ significantly. Finally, there was no significant interaction between sibling birth order and procedural subcategory, $F(1, 30) = 2.70$, $p = .61$, $\eta_p^2 = .009$. Older ($M = .11$, $SE = .03$) and younger ($M = .05$, $SE = .03$) siblings did not significantly differ in their teaching of game procedures. Older ($M = .15$, $SE = .03$) and younger ($M = .12$, $SE = .04$) siblings also did not significantly differ in their teaching of other procedures.

Parents' vs. Siblings' Conceptual and Procedural Teaching. We conducted a 2 teacher (parents, siblings) x 2 knowledge (conceptual, procedural) repeated-measures ANOVA to test the differences in parents' and siblings' proportions of conceptual and procedural knowledge. In this analysis and the following ones, mothers and fathers were combined into the variable of parents and older and younger siblings were combined into the variable of siblings. Findings demonstrated a significant main effect of knowledge $F(1, 36) = 314.63$, $p < .001$, $\eta_p^2 = .90$. Conceptual knowledge ($M = .82$, $SE = .02$) was taught more compared to procedural knowledge ($M = .18$, $SE = .02$). Additionally, results revealed a significant interaction between teacher and knowledge. Specifically, parents ($M = .88$, $SE = .02$) taught more conceptual knowledge compared to siblings ($M = .76$, $SE = .03$). On the other hand, siblings ($M = .24$, $SE = .03$) taught more procedural knowledge ($M = .12$, $SE = .02$) compared to parents (see Figure 1).

Parents' vs. Siblings' Conceptual Subcategory Teaching. A 2 teacher (parents, siblings) x 4 conceptual subcategories (social conventions, game discussions, language/literacy/math concepts, explaining concepts) repeated-measures ANOVA was conducted to test differences in teachers' proportions of subcategory teaching. Findings revealed a main effect of teacher, $F(1, 36) = 8.49$, $p = .006$, $\eta_p^2 = .19$. Parents ($M = .22$, $SE = .005$) taught significantly more compared to siblings ($M = .19$, $SE = .008$). The results also demonstrated a main effect of subcategory, $F(1.96, 70.43) = 3.71$, $p = .03$, $\eta_p^2 = .09$. Pairwise comparisons revealed only one significant difference, that language/literacy/math concepts ($M = .26$, $SE = .03$) were taught significantly more than explaining concepts ($M = .12$, $SE = .02$). Refer to Table 4 for a list of means and standard errors of conceptual subcategory teaching.

Findings also showed a significant interaction between teacher and conceptual subcategory, $F(3, 108) = 32.70$, $p < .001$, $\eta_p^2 = .48$. Parents taught significantly more about

social conventions (M = .37, SE = .05) compared to siblings (M = .003, SE = .003). On the other hand, siblings (M = .40, SE = .05) taught significantly more language/literacy/math concepts compared to parents (M = .13, SE = .02; see Figure 2). Parents (M = .25, SE = .04) and siblings (M = .24, SE = .05) did not significantly differ in their use of game discussions. Similarly, parents (M = .13, SE = .02) and siblings (M = .11, SE = .03) did not significantly differ in their use of explaining concepts.

Parents' vs. Siblings' Procedural Subcategory Teaching. A 2 teacher (parents, siblings) x 2 procedural subcategories (games, other) repeated-measures ANOVA was conducted to test the differences in parents' and siblings' use of procedural subcategories. Results demonstrated a significant main effect of teacher, $F(1, 36) = 8.49$, $p = .006$, $\eta_p^2 = .19$. Siblings (M = .12, SE = .02) taught significantly more compared to parents (M = .06, SE = .009). No significant main effect was found for procedural subcategory, $F(1, 36) = .006$, $p = .94$, $\eta_p^2 = .000$. Game procedures (M = .09, SE = .01) did not significantly differ from other procedures (M = .09, SE = .02).

Findings showed a significant interaction between teacher and procedural subcategory, $F(1, 36) = 5.47$, $p = .03$, $\eta_p^2 = .13$. Parents (M = .08, SE = .02) and siblings (M = .10, SE = .02) did not significantly differ in their use of game procedures. On the other hand, siblings (M = .14, SE = .03) taught significantly more other procedures compared to parents (M = .04, SE = .01; see Figure 2).

Parents' and Siblings' Knowledge Use by Initiation

The first part of our second research question aimed to compare mothers and fathers in their knowledge use by initiation. Do to the low statistical power of our data, we were unable to conduct these analyses. However, the second part of this research question examined whether

parents' and siblings' use of knowledge (overall, and by subcategory) varied according to who initiated the teaching sequence (e.g., teacher assumes role, learner requests). Previous analyses by Howe and colleagues (2015) revealed that when siblings initiated a teaching sequence, they conveyed procedural knowledge. On the other hand, when learners initiated a teaching sequences, siblings conveyed conceptual knowledge.

A 2 teacher (parents, siblings) x 2 initiation (assumes role, learner requests) x 2 knowledge (conceptual, procedural) repeated measures ANOVA was conducted to test for differences in parents' and siblings' knowledge use by initiation. To avoid repetition of findings for main effect of knowledge, only results for initiation will be considered.

Findings did not demonstrate an interaction between initiation and knowledge, $F(1, 15) = .02$, $p = .90$, $\eta_p^2 = .001$. Conceptual knowledge did not significantly differ between assumed role ($M = .84$, $SE = .02$) and learner requested initiations ($M = .83$, $SE = .05$). Similarly, procedural knowledge did not differ significantly during assumed role ($M = .16$, $SE = .02$) and learner requested initiations ($M = .17$, $SE = .05$). Similarly, although nonsignificant, a trend was found was found between teacher, initiation, and knowledge, $F(1, 15) = 4.19$, $p = .059$, $\eta_p^2 = .22$. Refer to Table 5 for proportion means and standard errors. Therefore, our hypothesis was not supported.

Parents' and Siblings' Knowledge Use by Context

The third research question aimed to determine whether parents' and siblings' use of knowledge varied according to the context of teaching (conflict, contingent activity, games). Previous analyses by Farhat (2019) demonstrated that mothers taught more during conflict, whereas fathers taught more during game contexts. Due to low frequency of some cells in the data, it was not possible to conduct the analyses for older versus younger siblings. Therefore, the

following analyses compared parents' and siblings' use of conceptual and procedural (overall) knowledge.

A 2 teacher (parents, siblings) x 3 context (conflict, contingent activity, game) x 2 knowledge (conceptual, procedural) repeated-measures ANOVA was conducted to test for differences in parents' and siblings' use of knowledge by context. To avoid repetition of previous findings for knowledge, results described here will solely be for context.

The results did not show a significant interaction between context and knowledge, $F(2, 14) = .64$, $p = .54$, $\eta_p^2 = .09$. Use of conceptual knowledge was similar during conflict ($M = .91$, $SE = .06$), contingent activity ($M = .86$, $SE = .05$), and games ($M = .81$, $SE = .08$). Additionally, use of procedural knowledge was similar during conflict ($M = .09$, $SE = .06$), contingent activity ($M = .14$, $SE = .05$), and games ($M = .19$, $SE = .08$).

Findings also did not reveal a significant interaction between teacher, context, and knowledge, $F(2, 14) = .283$, $p = .76$, $\eta_p^2 = .04$. During conflict, parents did not use significantly more conceptual knowledge ($M = .99$, $SE = .01$) than siblings ($M = .84$, $SE = .12$), nor did they use more procedural knowledge ($M = .01$, $SE = .01$) compared to siblings ($M = .16$, $SE = .12$). Similarly, during games, parents ($M = .87$, $SE = .03$) and siblings ($M = .75$, $SE = .13$) did not differ significantly in their use of conceptual knowledge. Additionally, parents ($M = .13$, $SE = .03$) and siblings ($M = .25$, $SE = .13$) did not significantly differ in their use of procedural knowledge. As a result, our hypotheses were not supported.

However, pairwise comparisons revealed one significant interaction between teacher, context, and knowledge. In the context of contingent activity, parents used more conceptual knowledge ($M = .98$, $SE = .02$) compared to siblings ($M = .74$, $SE = .09$), whereas siblings used more procedural knowledge ($M = .26$, $SE = .09$) compared to parents ($M = .02$, $SE = .02$).

Table 1

Descriptive Statistics for Teaching Frequency (Parents; Mother, Father; and Siblings; Older, Younger)

	Frequency	***M* (SD)**	**Range**
Parents	1145	30.95 (28.98)	0-123
Mother	432	11.68 (10.37)	0-57
Father	713	19.27 (25.98)	0-110
Siblings	434	11.73 (8.50)	0-42
Older	329	8.89 (7.58)	0-35
Younger	105	2.84 (2.51)	0-8

Table 2

Descriptive Statistics for Teaching across Context and Initiation

	Parents			Siblings		
	Frequency	*M* (SD)	Range	Frequency	*M* (SD)	Range
Context						
Conflict	244	6.59 (6.60)	0-34	44	1.19 (1.89)	0-8
Contingent Activity	257	6.95 (4.94)	0-21	288	7.78 (7.06)	0-42
Games	644	17.41 (25.36)	0-103	148	4.00 (4.61)	0-24
Initiation						
Assumes Role	1068	28.86 (27.36)	0-113	321	8.68 (5.92)	0-26
Learner Requests	77	2.08 (3.13)	0-13	112	3.03 (3.57)	0-17

Table 3

Descriptive Statistics for Knowledge Type (Overall and by Subcategory)

	Mother			Father			Older Sibling			Younger Sibling		
	Freq	*M* (SD)	Range	Freq	*M* (SD)	Range	Freq	*M* (SD)	Range	Freq	*M* (SD)	Range
Conceptual	370	10.00 (7.76)	0-38	602	16.27(21.27)	0-96	248	6.70(6.25)	0-28	83	2.24 (2.23)	0-7
Social Conventional	160	4.32 (4.28)	0-16	110	2.97 (2.71)	0-11	1	0.03 (0.16)	0-1	0	0.00 (0.00)	0-0
Game Discussion	102	2.76 (4.56)	0-17	354	9.57 (17.31)	0-78	101	2.73(4.76)	0-22	21	0.57 (.90)	0-3
Language/Literacy/ Math Concepts	46	1.24 (1.57)	0-7	89	2.41 (3.03)	0-12	106	2.86(2.74)	0-13	47	1.27 (1.45)	0-5
Explaining Concepts	62	1.68 (2.24)	0-11	49	1.32 (2.08)	0-9	40	1.08(2.39)	0-14	15	0.41 (0.76)	0-3
Procedural	62	1.68 (3.36)	0-19	111	3.00 (5.43)	0-26	81	2.19(2.05)	0-7	22	0.59 (1.17)	0-5
Game Procedures	49	1.32 (3.22)	0-18	98	2.65 (5.30)	0-25	40	1.08(1.55)	0-7	5	0.14 (0.42)	0-2
Other Procedures	13	0.35 (0.72)	0-3	13	0.35 (0.68)	0-3	41	1.11(1.35)	0-5	17	0.46 (1.04)	0-5

Table 4

Proportion Means and Standard Errors for the Main Effect of Conceptual Subcategory

	M	*SE*
Social Conventional	.19	.02
Game Discussion	.25	.04
Language/Literacy/ Math Concepts	.26[a]	.03
Explaining Concepts	.12[b]	.02

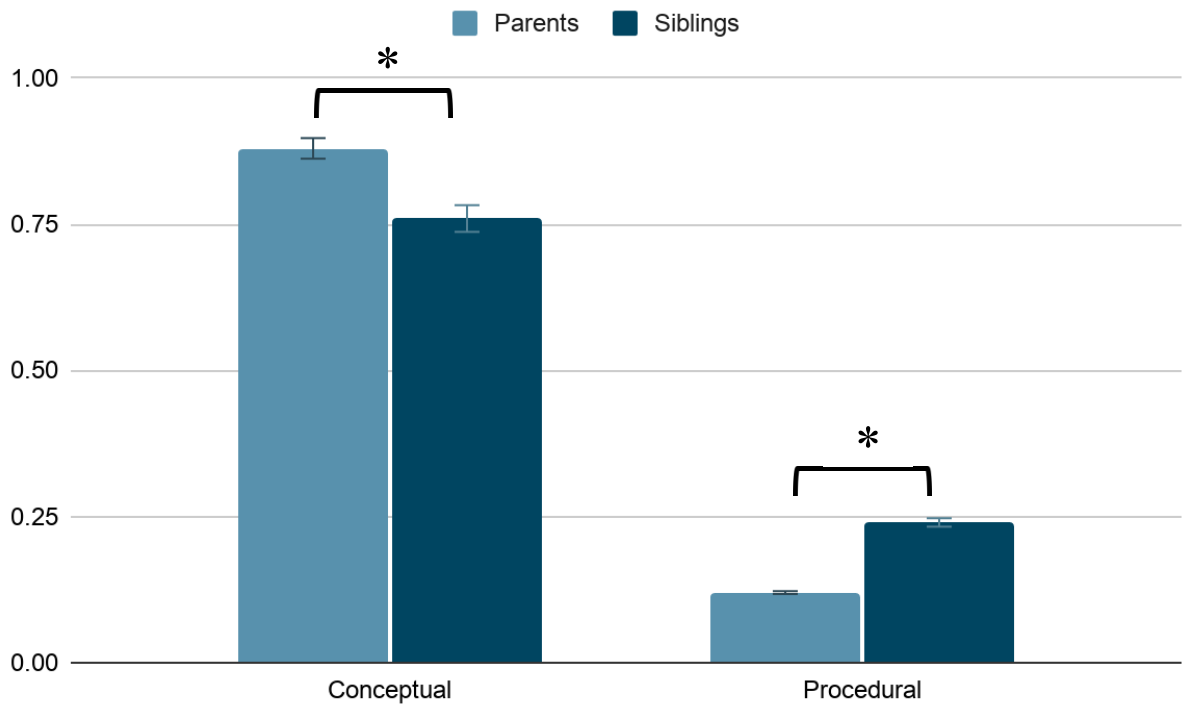
Note. a is significantly different than b ($p < .05$).

Table 5

Proportion Means and Standard Errors for Interaction Between Teacher, Initiation, and Knowledge

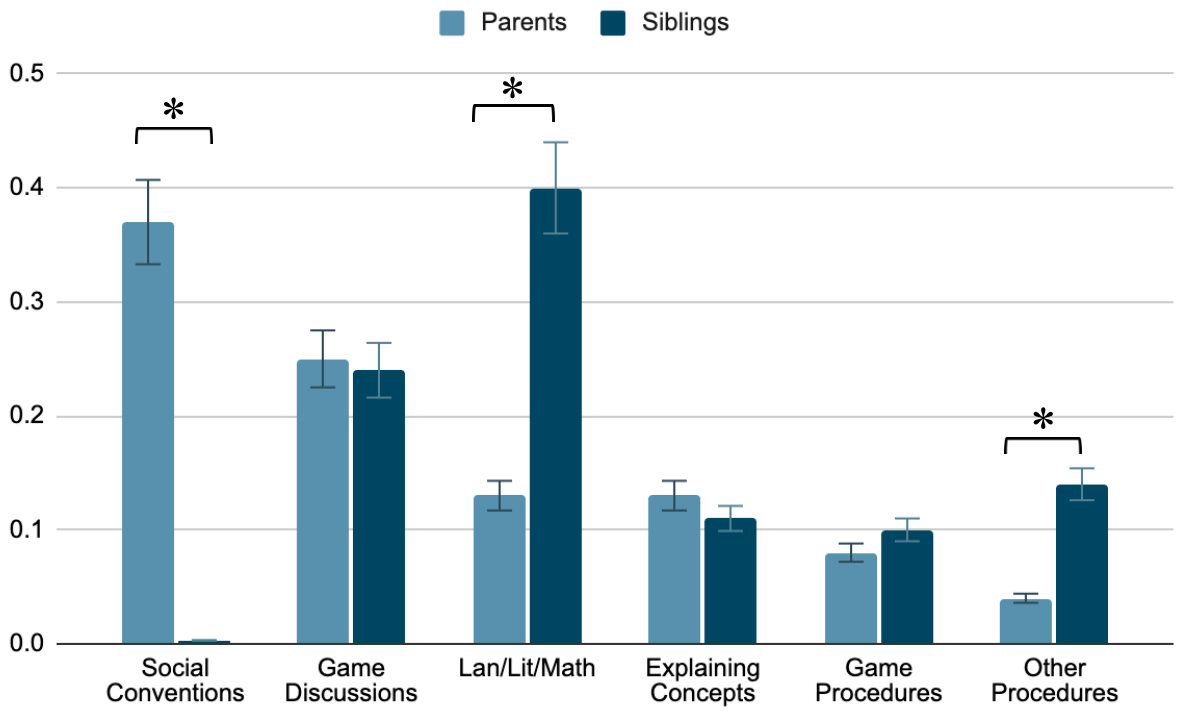
		Parents		Siblings	
		M	*SE*	*M*	*SE*
Assumes Role	Conceptual	.88	.03	.79	.04
	Procedural	.12	.03	.21	.04
Learner Requested	Conceptual	.79	.06	.87	.05
	Procedural	.21	.06	.13	.05

Figure 1. Parents' and Siblings' Knowledge Type Teaching Interaction



Note. *$p < .05$.

Figure 2. Parents' and Siblings' Subcategory Interactions (Conceptual and Procedural)



Note. *$p < .05$.

Discussion

The goal of the present study was to compare sibling-directed and parent-directed teaching as it occurred naturalistically in the home. In particular, parents' and siblings' use of conceptual and procedural knowledge, overall and by subcategory, was examined when they engaged in teaching. Parents and siblings were also compared in their knowledge use by context and initiation of teaching. The following sections will discuss these findings in relation to the original research questions and hypotheses, as well as their correspondence to the theory and literature. This discussion will also address the limitations of the present study, as well as future directions for research in this domain.

Parents' Teaching of Conceptual and Procedural Knowledge

The first research question asked to what extent do parents use conceptual and procedural knowledge when teaching their children? Mothers and fathers did not differ in their use of procedural knowledge. However, the first hypothesis predicted that mothers would use more conceptual knowledge compared to fathers (Farhat, 2019; McLaughlin et al., 1980).

Contrary to the hypothesis, mothers and fathers did not differ in their use of conceptual knowledge when teaching their children. This finding highlights patterns of similarity in the ways mothers and fathers teach their children. For the most part, mothers and fathers typically use the same teaching strategies, and use scaffolding to the same extent when teaching their children (Farhat, 2019; Pratt et al., 1988, Worden et al., 1987). This may indicate another aspect of similarity in the ways mothers and fathers teach. In light of these findings, and considering that no significant gender differences were identified in the present study; for the most part, gender roles may not influence differences in the type of knowledge parents convey.

Interestingly, results depicted that parents taught more conceptual than procedural knowledge. According to Howe and colleagues (2015), conceptual knowledge entails conveying information (i.e., using explanations and discussions) in a way that can help a learner apply it in unfamiliar contexts, where they may have to find ways to understand new concepts. On the other hand, procedural knowledge requires a teacher to demonstrate specific strategies that can help the learner to carry out a task. It is possible that parents find it more interesting or worthwhile to teach conceptual knowledge to their children, as this type of knowledge is more abstract in nature. Conveying more conceptual knowledge may be a way to prepare children to apply and understand new and more complex concepts in novel contexts.

This finding may also be reinforced by the methodology of the study. Previous research which utilized a semi-structured methodology employed tasks that were procedural in nature, such as completing puzzles, problem solving, and block construction tasks (Cicirelli, 1975; Cicirelli, 1976; Howe et al., 2006, Klein et al., 2002; Klein et al., 2003). Therefore, it could be that studies employing naturalistic methodology facilitate the identification of conceptual knowledge that occurred naturally and spontaneously; this differs from semi structured methodology, as these types of teaching behaviors may not be captured during predetermined and more structured tasks. It would be worthwhile to explore this question in future studies, by comparing parents' teaching during semi-structured tasks to their teaching during naturalistic observations as employed in the current study.

Parents' vs. Siblings' Use of Conceptual and Procedural Knowledge

When comparing parents and siblings in their use of conceptual and procedural knowledge use overall, parents taught more conceptual knowledge than siblings, whereas siblings taught more procedural knowledge compared to parents. Similar to previous

speculations, this may reinforce the idea that parents may prioritize conveying more abstract knowledge, in order to guide or prepare children to practice using this knowledge to expand their understanding (Howe et al., 2015).

Alternatively, this result may also be linked to the ways in which children plan their teaching. Previous literature demonstrated that children aged 5 to 6 years launched into teaching about completing step-by-step processes without demonstrating a form of planning (Cicirelli, 1976; Klein et al., 2002). This contrasted with parents' approach to teaching, which utilized expansions and questions about the nature of the semi-structured task (Klein et al., 2002). We know that children appear to demonstrate improvement in mediation skills (e.g., providing encouragement, feedback, outlining steps to complete a task; Klein et al., 2002) as they grow older, therefore, it may be the case that siblings' use of procedural knowledge may be linked to their more prominent experiences with completing and teaching about completing procedural tasks. On the other hand, developmental advantage and experience may explain why parents convey more conceptual knowledge in their teaching.

Notably, parents and siblings taught more conceptual knowledge overall (see Figure 1). Previous research also demonstrated that, like parents, siblings taught more conceptual than procedural knowledge (Howe et al., 2015). The limited literature comparing parents' and siblings' teaching outlined differences in their approaches to teaching (Cicirelli, 1975, Klein et al., 2002). The present findings contribute new insights on the similarities in parents' and children's teaching. The pattern of teaching more conceptual knowledge than procedural knowledge may emphasize the role parents play in guiding children's learning within the social world (Bornstein, 2015; Carpendale & Lewis, 2015; Hartup, 1989). Perhaps children reference their parents to guide the ways in which they teach their siblings (Bornstein, 2015). In other

words, children's early socialization experiences with their parents could guide their methods and approaches to teaching their siblings (Bornstein, 2015). However, it can only be speculated that this may be a result of children's modelling of their parents' teaching. Future study examining behaviors of modelling in the household, may reveal more nuanced details about how children take on the role as teachers in the home.

On the other hand, this finding may also reinforce children's natural ability to teach (Strauss et al., 2014; Ziv & Frye, 2004). Young children in this study appear to be teaching in similar ways to their parents, even though they may not have been explicitly taught to teach. It appears that parents work collaboratively with their children for new knowledge and skill acquirement, which emphasizes the bidirectional relationship between family members (LeBlanc & Bearison, 2004; Rogoff, 1998). In this regard, parents undoubtedly play a prominent role in helping children learn and teach (Hartup, 1989); children seem to be attuned to the ways their parents teach, and through this, they may translate what they learn into their own approaches to teaching (Strauss et al., 2014).

Parents' vs. Siblings' Use of Knowledge Subcategories

The final part of the first research question asked how parents and siblings compared on their use of conceptual and procedural knowledge by subcategory. As this was the first study to include subcategories of knowledge type, no hypotheses were made. Results comparing parents' and siblings' subcategory use for conceptual knowledge revealed that parents taught more social conventions compared to siblings. This finding appears to be aligned with the literature on parent-child relationships, namely, in the ways parents scaffold their children's learning during the early stages of childhood (Daniels, 2014; Palincsar, 1998; Rogoff, 1998). Concepts in the social convention subcategory included discussions surrounding expected household behaviors,

manners, etiquette, house rules, and safety. It is possible that parents place a great sense of importance on conveying concepts about social conventional behaviors compared to children, especially during the early stages of child development, and as a result this emphasis may be reflected in the knowledge parents convey to their children. Indeed, Smetana's (1999) social domain theory posits that social conventions are culturally bound; children learn to navigate the social world through their interactions with other social agents, and parents act as guides in helping children navigate these arbitrary, socially constructed rules.

On the other hand, siblings taught more language, literacy, and math concepts compared to parents. Using the same dataset, Segal and colleagues (2017) previously found that siblings increased their literacy instruction during the second time point (i.e., at ages 4 and 6), which corresponds to the same ages of children studied in the current study. In line with these findings, the children in the present study were close to, or of school age; it could be that this is a period of time in which children's interest in language, literacy and math increases (Segal et al., 2017). Therefore, it is possible that their increased interest in these types of concepts may have translated to the type of knowledge they conveyed to their siblings. Similarly, Howe, Adrien, and colleagues (2016) utilized the same dataset to examine siblings' teaching of early mathematics topics, and found that siblings conveyed conceptual knowledge more often when they discussed topics related to number than topics such as geometry and measurement. This finding may parallel the present result concerning children's teaching of math concepts. It could be that conceptual topics of math and literacy may be more salient for children aged 4 to 6 years (compared to social conventions, game discussions, and explaining concepts), and their extensive experience with these concepts may make them more confident in conveying them to their siblings. Clearly, this speculation warrants further study.

Findings regarding procedural subcategories demonstrated that, amongst siblings, there were no significant differences in the proportions of game procedures and other procedures taught. However, when compared to parents, siblings taught more other procedures. Other procedures constituted demonstrations or discussions about processes related to everyday activities, that were unrelated to games and play materials. For example, an older sibling demonstrated to their younger sibling how to put a pair of scissors back together. The similar proportion in game and other procedures conveyed by siblings may highlight their ability to adapt their procedural teachings to a variety of daily activities (Howe, Adrien, et al., 2016). In fact, Howe, Adrien and colleagues (2016) suggest that children may be attuned to the nature of an activity; in this case, children may be attuned to the ways in which procedural teaching may vary (i.e., during games and play versus other types of procedures).

Findings demonstrated that siblings taught more other procedures than did parents. Types of other procedures seen between siblings included demonstrations about how to draw, write, cut out materials for arts and crafts, as well as physical movements (i.e., how to kick like a donkey). On the other hand, other procedures viewed within parent-child interactions included explanations about how to get down from high places, guidance on cleaning up messes and toys, and suggestions for easier task completion (e.g., "if you move to that chair, then you won't have to reach so far"). One possible explanation for siblings' more frequent use of other procedures could be about the role parents take on in the home when interacting with their children. It may be that parents were more involved while playing games with their children, whereas other procedures may have arisen while parents were not as directly engaged. On the other hand, siblings may reference one another in their engagement with other procedures more so than with their parents. Considering that siblings spend a great deal of time together during early

childhood, it could be that they are more acquainted with each other's knowledge, abilities, and experiences (Dunn, 1983, 2015; Hartup, 1989), and as a result, may turn to each other when engaging in other procedures.

To our knowledge, this is the first study to examine subcategories of conceptual and procedural knowledge. According to Hatano and Inagaki (1986), examining knowledge types can demonstrate the expertise a teacher may hold, and can clue researchers into the types of knowledge they may convey while teaching. It would be interesting to further investigate conceptual and procedural subcategories in more diverse samples (i.e., socioeconomic and cultural background, as well as various family compositions) to see if the knowledge conveyed may be similar or different.

Parents' vs. Siblings' Use of Knowledge Use by Initiation of Teaching

The second research question asked whether knowledge type varied depending on who initiated the teaching sequence, and how parents and siblings compared in their knowledge use (overall, and by subcategory) according to initiation. Previous research found that learners who requested teaching from their sibling were taught conceptual knowledge, whereas siblings who initiated teaching conveyed procedural knowledge (Howe et al., 2015). Given these results, it was hypothesized that when parents initiated a teaching sequence, they would also convey more procedural than conceptual knowledge to their children. It was also predicted that, when a learner requested teaching, fathers would convey more procedural knowledge, whereas mothers would convey more conceptual knowledge (McLaughlin et al., 1980). As the statistical power did not allow for comparisons between mothers and fathers, comparisons were made between parents together and siblings together. Our analyses did not reveal any main effects or interactions for knowledge type by initiation, overall or by subcategory. Therefore, our hypotheses were not

supported. However, the findings depicted a trend, although nonsignificant, that siblings conveyed more procedural knowledge when they assumed the teaching role, which is in line with previous research by Howe and colleagues (2015). This may reinforce the idea that siblings use their experience with procedural knowledge to fill the gaps in each other's knowledge (Dunn, 1983; Strauss & Ziv, 2012), ultimately highlighting the bidirectionality of the sibling relationship (LeBlanc & Bearison, 2004).

Parents' vs. Siblings' Knowledge Use by Context

The third research question aimed to make comparisons about families' use of knowledge across contexts. Following from Farhat's (2019) findings that fathers taught more during game contexts and mothers taught more during conflict contexts, it was hypothesized that, since games are procedural in nature, fathers would teach more procedural knowledge during game contexts, and, since conflict requires justification and reasoning (Ross, 1994), mothers would teach more conceptual knowledge during conflict. Similarly, given that siblings were found to scaffold their younger sibling's learning during tasks they perceived as difficult (Abuhatoum et al., 2016; Howe et al., 2006; Howe, Della Porta, et al., 2016; Maynard, 2002), it was predicted that siblings would teach more in more structured contexts. Therefore, like fathers, older siblings were hypothesized to use procedural knowledge during games.

Due to low frequency of some cells in the data, it was not possible to conduct the analyses for older versus younger siblings. However, upon comparing parents and siblings, one significant pairwise comparison revealed that, during contingent activity, parents used more conceptual knowledge compared to siblings, but siblings used more procedural knowledge than parents. Contexts of contingent activity included interactions where both agents follow and respond to their partner's actions.

In essence, these findings may parallel with the results comparing parents' and siblings' knowledge use overall. Siblings use of procedural knowledge may be tied to their extensive experience with teaching about completing procedural tasks (Klein, 2002), whereas parents' developmental advantage may allow them to convey more conceptual knowledge when they teach (Abuhatoum et al., 2016).

Overall, the results of the current study shed light on the ways in which parents and siblings convey knowledge to one another in naturalistic environments. As a whole, these findings appear to support previous theory about how teaching occurs spontaneously and naturally (Strauss & Ziv, 2012). The findings may also reinforce that family members work together to fill the gaps in each other's knowledge, thus highlighting the bidirectional nature of family relationships (LeBlanc & Bearison, 2004).

Limitations and Future Directions

The present study contributed novel insight into families' teaching of conceptual and procedural knowledge as they occur naturalistically in the home, although it is not without limitations. The sample size of this study, 37 families, was relatively small, albeit representative of the population in southwestern Ontario during the time of data collection. Additionally, families who participated in this study were primarily White, from middle-class socioeconomic backgrounds, and of nuclear dyadic composition (i.e., mother, father, and at least two children); this does not entirely reflect the reality of all types of families, and thus may limit the generalizability of the findings. Therefore, future research which includes families from diverse cultural, compositional (e.g., mother-mother, father-father, families), and socioeconomic backgrounds can deepen our understanding of how teaching takes place naturalistically in different homes. Moreover, the data utilized in this study were collected in the 1980s; since the

data collection, there may have been a shift in family roles (e.g., more involvement of fathers within children's development; Bornstein, 2015). Nevertheless, fathers in the present study demonstrated a higher teaching frequency than mothers', which attests to the applicability of the present findings to today's families.

All data provided for the present study were written in the form of transcripts, which was beneficial for capturing rich details in families' communications and teaching through their conversations. However, various types of information, such as visual cues of families' behaviors, as well as visual expression, and sometimes tone of voice were absent from our interpretations. Future methodology could benefit from including audiovisual recordings in to capture a richer picture of families' interactions.

There were certain limitations in data analysis that warrant future study. For example, although comparisons in knowledge type were established between parents and siblings, the statistical power of the sample size did not permit analyses comparing mothers to fathers and older to younger siblings by context and initiation to take place. A larger sample size may facilitate these analyses to be conducted, which can paint a clearer picture about how each family member extends their knowledge to other members in the household.

Finally, the statistical power of the sample size did not allow for comparisons between older and younger siblings' use of knowledge by context. Although results demonstrated that parents used more conceptual knowledge during contingent activity compared to siblings, it is not entirely clear how siblings differ in their knowledge use in other contexts (i.e., games and conflict). It could be beneficial to further explore this question to obtain a clearer picture on how older and younger children convey their knowledge in different contexts.

Implications

The results of the current study provide valuable implications for research and family practices in the home. Previous research about teaching was rooted in semi-structured methodology, and warranted further exploration in naturalistic contexts. Using naturalistic methodology provides insight about how teaching occurs spontaneously in the home between family members (Strauss & Ziv, 2012; Strauss et al., 2014; Strauss et al., 2002) in real-life settings (Abuhatoum et al., 2016; Howe, Adrien, et al., 2016; Howe, Della Porta et al., 2016; Howe et al., 2015). Although semi-structured methodology can provide valuable insight on the types of teaching that take place during tasks that are procedural in nature, the findings from the present study suggest that naturalistic settings can provide a clearer picture on how parents and siblings convey conceptual knowledge in the home. Examining this type of knowledge can provide rich information about how children learn and convey abstract concepts in early childhood.

The findings from this study also reveal new insights on how teaching takes place in the home when parents take an active role. Previous studies on sibling teaching did not examine parental involvement (Abramovitch et al., 1979; Abuhatoum et al., 2016; Barr & Hayne, 2003; Howe, Adrien, et al., 2016; Howe, Della Porta, et al., 2016; Howe et al., 2015; Maynard, 2002, 2004; Segal et al., 2017). However, the current results highlight similarities and differences between mothers and fathers (i.e., in their use of conceptual and procedural knowledge, overall) and with their children. Understanding the types of knowledge parents convey to their children, and siblings convey to each other, has important implications for enriching children's learning opportunities throughout early childhood. It can allow parents to better understand the contexts and types of activities that are conducive for particular kinds of knowledge to be conveyed and practiced with their children.

Prior to the present study, research on teaching in early childhood emphasized investigation of teaching strategies (Abuhatoum et al., 2016; Howe et al., 2006; Howe et al., 2015). The shift in focus from teaching strategies to conceptual and procedural knowledge (and its subcategories) deepens and diversifies our understanding of the types of teaching that can be employed by parents and siblings. Similarly, broadening our understanding of various types of teaching has great implications for providing new insight on how families co-construct meaning and scaffold each other's learning (Rogoff, 1998).

Conclusion

Taken together, the findings from this study support theories about teaching in early childhood, and contribute novel insights about the roles parents and siblings take in conveying knowledge to one another. Parents and siblings play active roles in co-constructing knowledge, which is demonstrated through the similarities and differences in the types of knowledge conveyed. Notably, this study broadened the definition of teaching, and in so doing, reinforced the family as a unique context for providing valuable insight about learning and development in early childhood.

References

Abramovitch, R., Corter, C. & Lando, B. (1979). Sibling interaction in the home. *Child Development, 50*(4)*,* 997-1003. https://doi.org/10.2307/1129325

Abuhatoum, S., Howe, N., Della Porta, S., Recchia, H., & Ross, H. (2016). Siblings' understanding of teaching in early and middle childhood: 'Watch me and you'll know how to do it.' *Journal of Cognition and Development, 17*(1)*,* 180-196. https://doi.org/10.1080/15248372.2015.1042579

Azmitia, M., & Hesser, J. (1993). Why siblings are important agents of cognitive development: A comparison of siblings and peers. *Child Development, 64*(2), 430–444. https://doi.org/10.2307/1131260

Barr, R., & Hayne, H. (2003). It's not what you know, it's who you know: Older siblings facilitate imitation during infancy. *International Journal of Early Years Education, 11*(1), 7–21. https://doi.org/10.1080/0966976032000066055

Baumrind, D. (1966). Effects of authoritative parental control on child behavior. *Child Development, 37*(4), 887–907. https://doi.org/10.2307/1126611

Bensalah, L., Olivier, M., & Stefaniak, N. (2012). Acquisition of the concept of teaching and its relationship with theory of mind in French 3- to 6-year-olds. *Teaching and Teacher Education, 28*(3)*,* 303-311. https://doi.org/10.1016/j.tate.2011.10.008

Bloom, B.S., (1956). *Taxonomy of educational objectives: The classification of educational goals: Handbook I, cognitive domain.* Longman.

Bornstein, M. H. (2015). Children's parents. In M. H. Bornstein, T. Leventhal, & R. M. Lerner (Eds.), *Handbook of child psychology and developmental science* (7th ed., Vol. 4, pp. 55-132). Wiley. https://doi.org/10.1002/9781118963418.childpsy403

Carpendale, J. I., & Lewis, C. (2015). The development of social understanding. In R. M. Lerner (Ed.), *Handbook of child psychology and developmental science, cognitive processes* (7th ed., Vol. 2, pp. 381–424). Wiley. https://doi.org/10.1002/9781118963418

Cicirelli, V. G. (1975). Effects of mother and older sibling on the problem solving behavior of the older child. *Developmental Psychology, 11*(6), 749-756. https://doi.org/10.1037/0012-1649.11.6.749

Cicirelli, V. G. (1976). Mother-child and sibling-sibling interactions on a problem-solving task. *Child Development, 47*(3), 588–596. https://doi.org/10.2307/1128172

Daniels, H. (2014). Vygotsky and psychology. In U. Goswami (Ed.), *The Wiley-Blackwell Handbook of Childhood Cognitive Development* (Vol. 2, pp. 673-696). Wiley.

Diaz, R. M., Neal, C. J., & Vachio, A. (1991). Maternal teaching in the zone of proximal development: A comparison of low- and high-risk dyads. *Merrill-Palmer Quarterly, 37*(1), 83-107. https://psycnet.apa.org/record/1991-18706-001

Dunn, J. (1983). Sibling relationships in early childhood. *Child Development, 54*(4), 787-811. https://doi.org/10.2307/1129886

Dunn, J. (2015). Siblings and socialization. In J. E. Grusec, & P.D., Hastings (Eds.) *Handbook of socialization: Theory and research* (2nd ed, pp. 309–327). The Guilford Press.

Farhat, F. (2019). *Maternal and paternal teaching in a naturalistic home environment* [Unpublished thesis]. Concordia University.

Hartup, W. W. (1989). Social relationships and their developmental significance. *American Psychologist, 44*(2), 120–126. https://doi.org/10.1037/0003-066X.44.2.120

Hatano, G., & Inagaki, K. (1986). Two courses of expertise. In H. W. Stevenson, H. Azuma, & K. Hakuta (Eds.), *A series of books in psychology. Child development and education in Japan* (pp. 262–272). W H Freeman/Times Books/ Henry Holt & Co.

Hinde, R. A. (1979). *Towards understanding relationships.* Methuen.

Howe, N., Adrien, E., Della Porta, S., Peccia, S., Recchia, H., Osana, H. P., & Ross, H. (2016). 'Infinity means it goes on forever': Siblings' informal teaching of mathematics. *Infant and Child Development, 25*(2), 137-157. https://doi.org/10.1002/icd.1928

Howe, N., Brody, M. H., & Recchia, H. (2006). Effects of task difficulty on sibling teaching in middle childhood. *Infant and Child Development, 15*(5), 455-470. https://doi.org/10.1002/icd.470

Howe, N., Della Porta, S., Recchia, H., & Ross, H. (2016). "Because if you don't put the top on, it will spill": A longitudinal study of sibling teaching in early childhood. *Developmental Psychology, 52*(11), 1832-1842. https://doi.org/10.1037/dev0000193

Howe, N., Della Porta, S., Recchia, H., Funamoto, A., & Ross, H. (2015). "This bird can't do it 'cause this bird doesn't swim in water": Sibling teaching during naturalistic home observations in early childhood. *Journal of Cognition and Development, 16*(2), 314-332. https://doi.org/10.1080/15248372.2013.848869

Howe, N., Persram, R. J., & Bergeron, C. (2019). Imitation as a learning strategy during sibling teaching. *Journal of Cognition and Development, 20*(4), 466-486. https://doi.org/10.1080/15248372.2019.1614591

Howe, N., & Recchia, H. (2005). Playmates and teachers: Reciprocal and complementary interactions between siblings. *Journal of Family Psychology, 19*(4), 497–502. https://doi.org/10.1037/0893-3200.19.4.497

Howe, N., & Recchia, H. (2009). Individual differences in sibling teaching. *Early Education and 735 Development, 20*(1), 174–197. https://doi.org/10.1080/10409280802206627

Howe, N., Recchia, H., Della Porta, S., & Funamoto, A. (2012). "The driver doesn't sit, he stands up like the Flintstones!": Sibling teaching during teacher-directed and self-guided tasks. *Journal of Cognition and Development, 13*(2), 208–231. https://doi.org/10.1080/15248372.2011.577703

Howe, N., Rosciszewska, J., & Persram, R. (2017). "I'm an ogre so I'm very hungry!" "I'm assistant ogre": The social function of sibling imitation in early childhood. *Infant and Child Development, 27*(1), 1-17. https://doi.org/10.1002/icd.2040

Klein, P. S., Feldman, R., & Zarur, S. (2002). Mediation in a sibling context: The relations of older siblings' mediating behaviour and younger siblings' task performance. *Infant and Child Development, 11*(4), 321–333. https://doi.org/10.1002/icd.261

Klein, P. S., Zarur, S., & Feldman, R. (2003). Mediational behaviors of preschoolers teaching their younger siblings. *Infant and Child Development, 12*(3), 233-242. https://doi.org/10.1002/icd.287

LeBlanc, G., & Bearison, D. J. (2004). Teaching and learning as a bi-directional activity: Investigating dyadic interactions between child teachers and child learners. *Cognitive Development, 19*(4), 499–515. https://doi.org/10.1016/j.cogdev.2004.09.004

Maynard, A. E. (2002). Cultural teaching: The development of teaching skills in Maya sibling interactions. *Child Development 73*(3), 969-982. https://doi.org/10.1111/1467-8624.00450

Maynard, A. E. (2004). Cultures of teaching in childhood: Formal schooling and Maya sibling teaching at home. *Cognitive Development 19*(4), 517-535. https://doi.org/10.1016/j.cogdev.2004.09.005

McGillicuddy-DeLisi, A. V. (1988). Sex differences in parental teaching behaviors. *Merrill-Palmer Quarterly, 34*(2), 147-162. https://psycnet.apa.org/record/1988-26364-001

McLaughlin, B., Schutz, C., & White, D. (1980). Parental speech to five-year-old children in a game-playing situation. *Child Development, 51*(2), 580-582. https://doi.org/10.2307/1129297

Miller, P. H. (2014). Piaget's theory: Past, present and future. In U. Goswami (Ed.), *Wiley-Blackwell Handbook of Childhood Cognitive Development* (Vol. 2, pp. 649-672). Wiley.

Palincsar, A. S. (1998). Social constructivist perspectives on teaching and learning. *Annual Review of Psychology, 49*(1), 345–375. https://doi.org/10.1146/annurev.psych.49.1.345

Pérez-Granados, D.R., & Callanan, M.A. (1997). Parents and siblings as early resources for young children's learning in Mexican-descent families. *Hispanic Journal of Behavioral Sciences*, *19*(1), 3–33. http://doi.org/10.1177/07399863970191001

Pratt, M. W., Green, D., MacVicar, J., & Bountrogianni, M. (1992). The mathematical parent: Parental scaffolding, parenting style, and learning outcomes in long-division mathematics homework. *Journal of Applied Developmental Psychology, 13*(1), 17-34. https://doi.org/10.1016/0193-3973(92)90003-Z

Pratt, M. W., Kerig, P., Cowan, P. A., & Cowan, C. P. (1988). Mothers and fathers teaching 3-year-olds: Authoritative parenting and adult scaffolding of young children's learning. *Developmental Psychology, 24*(6), 832-839. https://doi.org/10.1037/0012-1649.24.6.832

Recchia, H., Howe, N., & Alexander, S. (2009). "You didn't teach me, you showed me": Variations in sibling teaching strategies in early and middle childhood. *Merrill-Palmer Quarterly,* 55(1)*,* 55-78. https://doi.org/10.1353/mpq.0.0016

Rogoff, B. (1998). Cognition as a collaborative process. In W. Damon (Ed.), *Handbook of child psychology: Cognition, perception, and language* (Vol. 2, pp. 679–744). John Wiley & Sons Inc.

Ross, H. S., Filyer, R. E., Lollis, S. P., Perlman, M., & Martin, J. L. (1994). Administering justice in the family. *Journal of Family Psychology, 8*(3)*,* 254–273. http://dx.doi.org/10.1037/0893-3200.8.3.254

Segal, A., Howe, N., Persram, R. J., Martin-Chang, S., & Ross, H. (2017). "I'll show you how to write my name": The contribution of naturalistic sibling teaching to the home literacy environment. *Reading Research Quarterly, 53*(4), 1-14. https://doi.org/10.1002/rrq.199

Sénéchal, M., & LeFevre, J. A. (2002). Parental involvement in the development of children's reading skill: A five-year longitudinal study. *Child Development, 73*(2), 445-460. https://doi.org/10.1111/1467-8624.00417

Smetana, J. G. (1999). The role of parents in moral development: A social domain analysis. *Journal of Moral Education, 28*(3), 311-321. https://doi.org/10.1080/030572499103106

Strauss, S., & Ziv, M. (2012). Teaching is a natural cognitive ability for humans. *Mind, Brain, and Education, 6*(4)*,* 186–196. https://doi.org/10.1111/j.1751-228X.2012.01156.x

Strauss, S., Calero, C. I., & Sigman, M. (2014). Teaching, naturally. *Trends in Neuroscience and Education, 3*(2), 38–43. https://doi.org/10.1016/j.tine.2014.05.001

Strauss, S., Ziv, M., & Stein, A. (2002). Teaching as a natural cognition and its relations to preschoolers' developing theory of mind. *Cognitive Development, 17*(3-4), 1473–1487. https://doi.org/10.1016/S0885-2014(02)00128-4

Tamis-LeMonda, C. S., & Rodriguez, E. T. (2009). Parents' role in fostering young children's learning and language development. *Encyclopedia on Early Childhood Development, 3,* 1-7. http://www.child-encyclopedia.com

Worden, P. E., Kee, D. W., & Ingle, M. J. (1987). Parental teaching strategies with preschoolers: A comparison of mothers and fathers within different alphabet tasks. *Contemporary Educational Psychology, 12*(2), 95-109. https://doi.org/10.1016/S0361-476X(87)80043-7

Ziv, M., & Frye, D. (2004). Children's understanding of teaching: The role of knowledge and belief. *Cognitive Development, 19*(4), 457-477. https://doi.org/10.1016/j.cogdev.2004.09.002

Appendix A – Sibling and Parent Teaching Coding Schemes

1) **Teaching Initiation** (Farhat, 2019; Recchia et al., 2010)
Initiation of teaching in each sequence could occur for the following reasons:

Category	Example
LR= Learner requests information or how to do something or directly asks for teaching. Code as request for teaching only when directed towards teacher. Request can also be implicit such as learner showing that they are having trouble with something.	**Transcript 335, lines 16-22:** O and Y are discussing wheelchairs that Y has seen at school. O asks Y: "Matt, I have a question. Were the wheelchairs electric or did they have to go like that with the wheels, or did somebody have to push them?" Y describes to O: "Somebody had to push them but sometimes they getted to push the wheels." O agrees with Y: "Yah."
AR= Assumes teaching role: Teacher just starts engaging in direct teaching or announces that he/she is teacher. For example, if learner makes a mistake and the teacher corrects the learner. "There's no "e" in baby bear". It can be very implicit.	**Transcript 014, lines 783-792**: O and Y are playing with Lego together. Y has put a piece on upside down. O shows verbally to Y: "See, it's supposed to go like this one, Christie." Y: no response.

2) **Context of Teaching (Ross et al., 1994):** The context of each teaching sequence was coded for one of the following context codes by Ross et al. (1994).
   - **CO = Conflict**: A sequence of interaction in which there is an incompatibility of the behavior of two people. The action of one person is met with protest, resistance, a retaliation by the other person. Brief disagreements that do not consist of more than one move from each partner can occur within sequences that are not conflicts. These brief interchanges do not change the interaction in to a conflict.
     - **Can also constitute family conflict**: A sequence of interaction which includes one or both of the parents as combatants with their children. Family conflicts arise when (1) a sibling conflict moves into a parent child conflict and the parent becomes a combatant in the conflict rather than just a mediator and (2) an issue of sibling treatment is discussed such as when a parent instructs one child on how to treat a sibling.
   - **CA = Contingent activity**: A sequence of interaction in which the actions of both people follow an action by the partner. Additionally, the actions appear to be in response to the partner's actions.
   - **GA = Game**: A sequence of interaction that is nonliteral in which the partners are mutually involved, alternate turns, and repeat their roles.

3) **Conceptual and Procedural Knowledge**

Conceptual knowledge entails one's understanding of information about ideas that exist in the world, and ability to explain why they exist and function (Hatano & Inagaki, 1986; Howe et al., 2015). Conceptual knowledge includes concepts, labels and general knowledge, which allow one to draw meaning about a familiar surrounding environment and apply that meaning in unfamiliar contexts, in order to develop a new understanding (Hatano & Inagaki, 1986; Howe et al., 2015).

Conceptual knowledge has been divided into five distinct sub-categories:
(a) **social and conventional behavior** (e.g., discussion surrounding expected behavior, manners, etiquette, house rules, and safety),
(b) **game discussion** (e.g., discussion surrounding the rules, purpose, or object of a game),
(c) **language/literacy/math concepts** (e.g., providing or defining the name of an object or idea, or discussing mathematical concepts, such as numbers or literacy concepts such as writing and/or spelling)
(d) **explaining concepts related to problem solving or prevention** (e.g., discussion and explanation surrounding troubleshooting or preventing problems related to concepts, i.e., regarding the process of how something works; discussion about why or how something works/is the way it is. May be identified through discussing rules that govern a concept or idea, or through use of key words, like: "because" or "since.").

Procedural knowledge entails one's understanding of how to do something, and ability to carry out steps to put something together (Hatano & Inagaki, 1986). Procedural knowledge includes one's application of strategies to complete step-by-step processes within a task, by physical demonstration, and/or discussion about how to do so (Howe et al., 2015).

Procedural knowledge has been divided into two distinct sub-categories:
(a) **game procedures** (e.g., demonstrating or discussing processes related to games and/or play materials).
(b) **other procedures** (e.g., demonstrating or discussing processes related to everyday activities, unrelated to games and/or play materials).

Goals: If we sub-categorize these types of knowledge, we can make comparisons to see what specific types of conceptual and procedural knowledge parents and children use; see if they differ from one another; and see if the categories vary depending on the context of the teaching sequence, and/or who initiates a teaching sequence.

The following are examples from the Waterloo dataset for coding **parents**:

Conceptual Knowledge Subcategories

Social and conventional behavior:
Discussion or explanation regarding the appropriate way to act within the family unit and/or household. Examples include discussion surrounding proper or expected behavior, manners, and etiquette; house rules; and safety.

Ex: Proper Behavior, Manners, Etiquette

Please/Thank you
- Say thank-you
- "What do you say?" (as a prompt to say please/thank-you)

Apologize
- "Say you're sorry, that's rude"
- FM getting Y to apologize to O for biting him

Sharing
- O had asked M for gum and F had asked if there were two pieces in there. M tells O he'll have to split it
- "No, you share them"
- M asked Y to share the crayons

Turn-taking
- M suggests that when they're moving in one direction OY can both be bus drivers, but when they're going the other way one of the siblings can drive

Being nice/not being rude
- "Be nice", or "that's not nice"
- F telling OY he doesn't want to hear either of them saying "shut up" to anybody again" as it is not nice

Tattling
- F to O: "But if it's not going to hurt somebody, I really don't think it's right to (tattle)"

Screaming
- M is trying to tell OY that screaming is not necessary (they're fighting over a doll)
- M tells O not to scream because "you can hear it upstairs and the baby is trying to sleep"
- M to Y: "It's too noisy"

Hitting

- M tells Y that “every time (he) starts to rage he can't hit”
- M to O: “Don't hit anyone on the head”.
- M telling Y he doesn't “hit someone with scissors, or paint brush or whatever it is”

Table manners

- F to O: "You know what behavior is expected at the table. That's not it"
- M asks Y, "How many times has mom told you not to jump around and throw things at the table?"

<u>Ex: House Rules</u>

Forbidden rooms

- M tells Y "You're not allowed in my room"

Running and jumping

- No running inside the house
- “If you’re going to run around, go downstairs”
- “You can’t play tag in the hallway”
- FM telling OY to go downstairs to jump around and that “there's no running upstairs or jumping off the chesterfield”
- “There’s no jumping off the bed”

Household items

- Children told not to throw or rearrange the furniture
- Children told not to hit, knock, or bump the walls
- O tells Y not to touch fragile objects because they might break.

Dinner rules

- Children told not to leave the dinner table until they have finished eating.

Ex: Safety

Related to objects or hazardous materials

- M tells O that if she keeps fooling around then M “might accidentally poke her tonsils with the toothbrush and (she) could get hurt”
- M says "careful, you'll choke" because Y had put the die in her mouth
- “Careful with the dice, you could hit somebody”
- F tells OY "Do you want to get that crayon before somebody steps on it"
- M asking Y to settle down before she hits and knocks over the iron over
- M tells OY they were told not to walk around because they're working with hot oil (in the kitchen)
- “Why don't you move the broom so no one lands on it and breaks it"

Related to physical actions or stunts

- F telling O that she'll flip off the chair if she keeps bouncing
- Sit straight or you might fall
- Y was telling F that O threw her off and F says "You were playing bucking horse, weren't ya? Bucking horse hurts people."
- O asks if Y is ok and M says of course she isn't because O dragged her halfway across the room
- F tells O not to pick up people, “It's too dangerous.”
- F says it's dangerous to do (the acrobatics/wheelbarrow) indoors, and that it's a different story on the grass outside

Game Discussion:
Providing, reminding, or explaining the rules of a game; and discussion about behavior during games (e.g., rolling dice before moving spaces on a game board); or discussion about strategies (e.g., I didn't have the card before so I don't have it now – go fish); or discussion surrounding cheating or playing fairly. Also includes discussion about play materials
(e.g., Transcript 76, lines 429-430: "this is how you turn on the motor on the Barbie car.")

Game etiquette

- Requesting certain behavior through game play, e.g., requesting a child not move others' game pieces on the board because they don't know where they were originally.
- Asking not to hit the table, otherwise game pieces scatter and they don't know where they originally were.
- Not looking or peeking at game cards (either through the deck or someone's hand of cards)

Strategies

- Any form of reasoning or strategizing throughout a game (e.g., in snakes and ladders: "2 or 4 would be good; a 5 would be bad")
- "Go for another snake so you can get this one."

No cheating/playing fairly

- F tells O if she's going to play she has to go where it says to go
- Y was going to tell O what the card was. F says "Don't tell her, that's cheating"
- M tells Y "You can't win by cheating"

Rules and discussions during specific games

- **Pictionary**: Rules such as not guessing the word when it isn't your turn, and watching the person draw to make a guess.
- **Go-Fish:** Identifying pairs ("We've got a pair here"); explaining that if he didn't have the card last round, chances are he doesn't have it this round; reminding to say "Go fish" if you don't have the card; You can't just give one card if you have two; If someone has a match, you get to ask again
- **Hot-cold game:** Reminding to use the words "hot" and "cold" (understand what they mean in the game)

- **High-card wins:** Reiterating the rule that the high card wins, or asking which card is the highest (e.g., “Y asks F if king is the highest card and F says yes”); Labelling cards in a deck and identifying which cards are higher/lower than others
- **Old maid:** Pick cards from the person to your right; don’t tell anyone when you have the old maid
- **Snakes and Ladders:** You go up ladders and down snakes; You have to roll the dice before moving your game piece

Other game discussions

- Whose turn it is in the game
- “You dealt (the cards) so I ask first” (turn-taking/rule)
- Identifying if you’re going the wrong way on the board (without pointing)

Language/literacy/math and other concepts:

Providing, defining, or requesting the name of an object, word, label, or idea. Discussion may surround topics about math (e.g., numbers) and/or language and literacy (e.g., spelling, identifying letters). Discussion may also include factual information (such as information about dinosaurs presented through reading a story). Sequences discuss the function or purpose of an object, (i.e., a ruler is used to measure the length of something), or making comparisons/contrasts also apply here.

Also includes categories and classifications, involving discussion of objects or ideas that fall within certain broad conceptual categories (e.g., days of the week; money).

Language/literacy concepts

- Identifying or explaining letters, and word/meaning, e.g., “That’s a k”
- Correcting word use or phrase use, e.g., FM correct Y that the saying is "You're beating my pants off,"

Math concepts

- F tells O that seven is higher than six
- Corrections for numbers (e.g., Y had said 40 instead of 34 so F corrects him saying "34")

Labels

- F says "nine of what" and points to cards and says "diamonds"
- "That's a 10 of clubs"
- “That’s called a hand (of cards)”
- O was moving around her dessert like a car. M says it looks like a hard hat, like a construction worker.

Sibling examples of labels

- Transcript 92 (lines 571-573): “This is where you keep the onion.”
- Older sibling says “This is the last day of school” (points on a calendar)
- This is the doll that’s ripped

Informative

- M is showing OY the world map and they're discussing where they live and where their grandmother lives
- F reading a story about the dinosaurs and how they roamed the earth long ago (informative)
- F tells OY what chipmunks do with the nuts they gather. MF talk to OY about what bears do in the winter
- M was talking to O about dogs and how they can bite

Sibling examples of giving information

- “Mine’s a submarine so it can go underwater too”
- “Sarah did you know that raindrops are always different?”

Compare/contrast

- difference between gorilla and monkey

Sibling examples for Categories/classifications (NA for parent data)

- O tells Y: “This is Monday, this is Tuesday, this is Wednesday…this is Thursday, this is Friday, and Saturday”
- Y asks O: “And what kind of coin is this?” O responds: “It’s five cents.”

Explaining Concepts (related to Problem-Solving or Prevention of Problems): Discussion and explanation surrounding troubleshooting or preventing problems related to concepts (i.e., regarding the process of how something works). Also explaining any concept, how or why it is the way it is (e.g., "That's what happens when you put too much in.")

Related to play materials

- "Put (the pieces) in the box so the pieces don't get lost"
- In game of old maid, the family only has a standard 52-deck card, so they decide the joker will be used as the old maid card.
- OY had lost a red game piece for snakes and ladders. M suggests they use a button to replace it
- Y was putting marbles down a tube for O to catch. M tells Y "Somebody should catch them at the end or we're going to be stepping on them."
- "If you roll the die on the carpet, they won't scatter everywhere"

Problem solution

- Balloons are tangled. F suggests that O untangle them; "Open up the knots to avoid cutting the strings"
- MF are discussing how to get the balloon down (paraphrase: pop with pin or take the whole fan down)
- Y is trying to make the train go faster on the track. M says Y might find it and that it might be better to pull the train instead of pushing it

Problem prevention

- F tells Y that if he breaks the material (to make the spider web) "then they won't have enough left to make something"
- F tells Y that if he starts "flipping pages in the recipe book, they'll lose the right page and make two different recipes together"
- M tells Y they should be counting "how many balloons they're hiding, otherwise they'll lose track"

Related to explaining a concept

- M had made hot chocolate and Y had said "Hot! Hot! Hot!" so M said "You might have to blow on it."

- O is putting a mixture together and asks F if they can take it out now. F says "I don't think it's thick enough yet. That'll stick too much. We have to add some flour to it."
- O asks why structure won't stay. F tells O to "put another leg in because the structure is too tall." F shows her.
- F tells O that "the longer she waits, the colder the food will get"
- F explaining to OY that salt acts like a softener in water

Related to explaining a concept (but giving incomplete answers; siblings)

- This is applesauce because it tastes like applesauce
- Y asks, "Why do these work on paper? (pens for Spirograph). O says "They just do."
- "Why are they call pastels? Because that's their name. There's 12."
- "Wanna know why this is a little table with little legs? Cause it's a little table. Little, little, little."

Procedural Knowledge

Category	Examples
Game procedures: Demonstration or discussion about how to engage in task-specific activities, such as those depicted concretely in games or with play materials.	- F explains to O how to **deal the cards** correctly - O asks how F shuffles. F shows how to **shuffle** a deck of cards - Y was **arranging cards** and F says "No, one more up. Put that one up. Take one and put it up." - M shows O the direction to **shuffle the cards** and how to hold the cards to shuffle them more easily - F is going through step-by-step to put one card face down, then another face-up and compare the cards - F shows OY how to **shuffle the cards** by splitting the deck in half and spreading them with the thumb - F pointing out where the **number of spaces** are on the board - O shows Y how to set up Lego pieces - O shows Y how to mark a Bingo card - O demonstrates to Y how to play tic-tac-toe
Other procedures: Demonstration or discussion about how to engage in techniques that apply to generalized skills that can be used in a variety of everyday/real-world contexts (e.g., how to draw, write a number; zip a bag).	- O asks how to get down; F says to jump - OY were helping F put things away in his workshop. As Y was trying to put the tubes away, F says "Put it down on the floor (first), then open the door." - Y doesn't know where to start cleaning up. M suggests starting with the blocks - O demonstrates to Y how to draw a cow, and how to write the letter L - Y demonstrates to O how to kick like a donkey - Y shows O how to make cut-out art from paper

Types of Conceptual and Procedural Seen

- (Old maid) F explains (**conceptual)** and demonstrates (**procedural**) to Y how to put down matching cards and to fan the cards; F corrects Y that is has to be pairs, not 3s
- F is demonstrating **(procedural)** and explaining (**conceptual)** the game to OY (put ball under cup and move it around)
- O explains (**conceptual**) to Y that the scissors (that are separated) will "be broken forever … unless you go like this" and demonstrates (**procedural**) how to put them back together.
- O describes to Y what a cup is for a baby doll (**conceptual**) and tells Y to "pour that in (the cup)" before feeding the baby (**procedural**).
- Y tells O to lay on the floor and place their head on the ground (**procedural**) and that she has to "do it like the duckies hatch their egg" (**conceptual**)

Appendix B – Gender and Gender Composition Findings

The purpose of this appendix is to outline the significant effects revealed for gender and gender composition. Given the marginal effects, analyses did not control for gender and gender composition.

Two effects for initiation were found for the younger child (siblings' conceptual teaching during assumed role initiation type, $p = 0.015$; siblings' conceptual teaching during learner requested initiation type, $p = 0.033$), and one was found for gender composition (brothers' conceptual knowledge teaching for assumed role initiation type was higher on average compared to sister pairs, $p = 0.049$).

Furthermore, one effect for context was found for the older child (parents' procedural knowledge teaching during conflict, $p = 0.033$).

Finally, three effects for knowledge type were found for the younger child (mother's use of other procedures, $p = 0.045$; younger child's use of conceptual knowledge, $p = 0.002$; and younger child's use of explaining concepts, $p = 0.003$), and one was found for gender composition (younger child's use of explaining concepts, $p = 0.015$).