The Identification and Establishment of Reinforcement for Collaboration in Elementary Students

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ABSTRACT

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In Experiment 1, I conducted a functional analysis of student rate of learning with and without a peer-yoked contingency for 12 students in Kindergarten through 2nd grade in order to determine if they had conditioned reinforcement for collaboration. Using an ABAB reversal design, I compared rate of learning as measured by learn units to criterion under two conditions: (A) rotated learn units between 2 peers with a peer-yoked contingency game board (collaborative reinforcement), and (B) rotated learn units between 2 peers without a peer-yoked contingency game board (individual reinforcement). In these conditions, 2 students sat side by side and learn units were delivered in a rotated fashion. A peer-yoked contingency game board in which two characters competed to reach the top and access a predetermined backup reinforcer was present in the (A) condition only. The participants were yoked together on a “team,” and if they emitted a correct response, their character moved up on the game board. Seven of twelve participants learned faster in the collaborative reinforcement condition, suggesting that they each had reinforcement for collaboration with a peer. These data demonstrated how yoked contingencies can be utilized to increase rate of learning in the classroom when reinforcement for collaboration is present. The other participants learned slower in the collaborative reinforcement condition, suggesting that reinforcement for collaboration was not present for these participants. Additionally, participants who demonstrated reinforcement for collaboration emitted higher levels of vocal verbal operants when yoked with a peer than the participants who did not demonstrate reinforcement for collaboration. In Experiment 2, the participants who did not
demonstrate reinforcement for collaboration were placed into a collaborative intervention, in order to determine if this potential developmental cusp could be established. In a delayed multiple probe design across dyads, four participants engaged in peer tutoring with a confederate peer, and a yoked contingency game board was utilized to reinforce their effective collaboration. Following this intervention, all four participants demonstrated a faster rate of learning when yoked with a peer, as well as increased levels of vocal verbal operants with their peers. These findings suggest that an intervention that specifically targets reinforcement for collaboration through a peer-yoked contingency may be effective in inducing reinforcement for collaboration. The educational significance and implications of this potential developmental cusp are discussed.
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DEDICATION

I dedicate this work to my parents, as they have dedicated themselves to me and my education. I hope I have made you proud.
Chapter I
INTRODUCTION AND REVIEW OF THE LITERATURE

Introduction

B.F. Skinner posited that the problems in American education could be solved if students learned more content in less time (1984). Effective teaching practices should result in increased student learning; if they do not, then an in-depth assessment of what happens in the classroom should be applied swiftly. A teacher who functions as a strategic scientist (Greer, 1991) can create environmental contingencies within her classroom to set her students up for success academically, behaviorally, and socially. “Teachers require pedagogical tools commensurate with their responsibility-- ones that are powerful enough to teach all children until they have fluent mastery of repertoires needed for their well-being and that of society” (Greer, 1991, p. 28).

Through the deliberate implementation of a technology of teaching—one that utilizes evidence-based methods and systematically addresses students’ learning needs—teachers can improve their student outcomes. Research has shown that effective teaching methods impact overall outcomes for all students (Casarini, Catavelli & Cavallini, 2011; Greer, Keohane & Healy, 2002; Lamm & Greer 1991; Selinske, Greer & Lodhi, 1991; Singer-Dudek, Speckman & Nuzzolo, 2010).

The strategic teacher-scientist is constantly assessing her students’ learning, and searching for the key to unlock each student’s individual potential. Through the study of Verbal Behavior Development (Greer & Du, 2015; Greer & Keohane, 2005; Greer & Ross, 2008; Greer & Speckman, 2009), researchers have identified specific developmental milestones that may contribute to students’ success in school. Students’ levels of verbal behavior can impact not just
what students learn but how they learn (Eby & Greer, 2017; Greer, Corwin, Butti cig, 2011; Greer & Cahill, 2016; Greer & Du, 2016; Schmelzkopf, Greer, Singer-Dudek & Du, 2017). Verbal behavior researchers have posited that these developmental milestones, referred to herein as cusps and capabilities, are directly related to conditioned reinforcement (Greer & Du, 2015). A cusp allows a child to contact new contingencies in their environment (Rosales-Ruiz & Baer, 1996), and a cusp that is also a capability also allows a child to learn in new ways that they couldn’t before (Greer & Keohane, 2005; Greer & Ross, 2008; Greer & Speckman, 2009).

As verbal behavior is social behavior (Skinner, 1957), and the vast majority of students in the United States today are taught in a group setting, it is essential to investigate and further understand the role of social reinforcement in student learning (Eby & Greer, 2017; Greer & Du, 2015; Schmelzkopf, Greer, Singer-Dudek & Du, 2017; Tomasello, 2016). Specifically, reinforcement for collaboration with a peer is an area that requires further study. In a group setting, students must learn from and with their peers (Tomasello, 2016, p. 648). Reinforcement for collaboration is a potential developmental cusp that allows students to come into contact with collaborative contingencies within their environment (Greer & Du, 2015; Greer & Ross, 2008).

Recent research has shown that children are more motivated to engage in problem solving and to persist in difficult tasks when collaborating with a peer (Rekers, Haun & Tomasello, 2011); it has even been demonstrated that students solve problems more effectively when collaborating (Kuhn, Hemberger, & Khait, 2014). Although various studies have been conducted on how collaboration may affect student learning, according to Tomasello (2016, p. 648) “we do not know why.” Moreover, the question remains how this may impact students who do not demonstrate reinforcement for collaborating with a peer in an educational setting. In
order to further investigate the various mechanisms involved in collaboration among elementary aged students, I will discuss conceptual, applied, and translational research in recent educational literature, comparative developmental psychology, and behavior analysis. Additionally, I will explore the conceptual underpinnings of social reinforcement, and the overall role of conditioned reinforcement in student learning.

**Review of Literature**

**Collaboration in the Elementary School Classroom**

“In general, collaboration is key to cultural learning and transmission,” (Tomasello, 2016 p. 649). Tomasello discusses collaborative learning in the context of transmission of information between peers and co-creation of new information as a result of collaboration (Tomasello, 2016, p. 649). While collaboration as a broad concept can be referenced throughout the study of human evolutionary history (McLoone, 2012; Tomasello, 2014; Tomasello, 2016), in this paper it will be analyzed specifically through the lens of elementary education.

There has been a wide body of research conducted in the last two decades on the effects of collaboration and/or collaborative learning in an educational context--from its effects on interpersonal skills (Ladd, Ladd & Visconti, 2014) and relational thinking (Lin, Jadallah, Anderson, Baker, Nguyen-Jahiel, Kim, Kuo, Miller, Dong, & Wu 2014) to self-efficacy (Poellhuber, Chomieene, & Karsenti, 2008) and learning-through-design technology (Ching & Kafai, 2014). Each of the aforementioned studies share one common theme: students who collaborated effectively were reported to have better interpersonal skills and overall better performance on academic or problem-solving tasks. These studies provide useful information on the importance of the role of collaboration in an educational setting, but do not demonstrate how
reinforcement for collaboration can be identified or established in students who do not engage in collaboration effectively. Indeed, they do not take into consideration the ontogeny or phylogeny of the source(s) for collaboration; in the present study I seek to address this void in the research.

Furthermore, Whimbey (1986) investigated the importance of the interaction between two individuals in order to engage in effective problem solving. Lockhead and Whimbey (1987) created the *Think Aloud Problem Solving (TAPS)* method to teach children to engage in problem solving as both a listener and speaker. Recent research in this method has further developed the role of each participant in problem-solving and defined a dialogue that can be taught to individuals who lack problem solving repertoires (Muis, Psaradellis, Chevrier, Leo, and Lajoie, 2015; Robbins, 2011). While these researchers identified a dialogue and training procedure to facilitate this “think aloud” approach, they do not account for the source of reinforcement of problem-solving behaviors. It could be argued that in an approach like TAPS, it would be necessary for a child to have reinforcement for collaboration in order to effectively engage in problem-solving as both a listener and a speaker. This provides further evidence to support the importance of an investigation into the role of reinforcement for collaboration in the classroom.

**Cooperative learning and collaboration.** “Collaborative learning” and “cooperative learning” are widely used terms that have various meanings across educational and psychological contexts (Dillenbourg, 1999). These terms are often interchangeable. Buchs, Filippou, Pulfrey, and Volpe (2017) define cooperative learning as a pedagogical approach that “involves small teams working together in order to support all members’ learning” (p. 296). For the purposes of this paper, the terms collaborative OR cooperative learning refers to learning that occurs with and through peer interaction in a classroom, which is facilitated by social reinforcement (i.e.
reinforcement for collaboration).

Research has shown that collaborative learning increases academic engagement and overall achievement (Wentzel & Watkins, 2002). Collaborative learning has also been found to impact motivation and effort, interpersonal relationships, and the psychological health of students (Johnson & Johnson, 2009, p. 375). Laal (1995) found statistically significant differences in the critical thinking skills of students who learned individually and students who partook in collaborative learning. As such, educators have utilized collaborative learning across all levels of education to improve outcomes for students (Johnson & Johnson, 2009).

Cooperative learning has been studied and found to be an effective pedagogical method across various disciplines in elementary school, from physical education (Bradford, Hickson, & Evaniew, 2014) to STEM (Luo, 2015; Thurston, Christie, Karagiannidou, Murray, Tolmie & Topping, 2010).

Mastropieri, Scruggs, and McDuffie (2007) summarized 32 studies in a metasynthesis of research on effective co-teaching practices in inclusive classrooms. From these qualitative findings, the authors noted that peer mediation and cooperative learning in inclusion classrooms was an important, but underused, tactic that should be utilized in inclusive classroom practices (p. 410). They also cited increased collaboration between students as a potential benefit for students both with and without disabilities in co-taught classrooms (p. 401). Buchs et al (2017) further report that although cooperative learning has been established as having many benefits for students in the elementary classroom, teachers are often challenged by its implementation. Out of 207 teacher participants, only 31% reported utilizing cooperative learning in their classrooms on a regular basis. As collaboration and cooperative learning have been identified as
useful pedagogical methods, especially in inclusion classrooms, it can be concluded then that it is necessary for teachers to understand the source of these behaviors, in order to be able to implement these tactics most effectively.

The inclusion paradigm. Inclusion is a progressive movement and valued practice in current American educational policy and practice (Danforth & Narain, 2015; Hehir & Katzman, 2012; Salend, 2011). Federal legislation mandates that all students be entitled to a free and appropriate public education, in the least restrictive environment. This right is extended to students regardless of gender, religion, race, or ability. Inclusion can be both a social philosophy and an educational practice (Brownell, Smith & Crocket, 2012). For the purposes of this paper, “inclusion” refers to the practice of including students with disabilities in general education classrooms to the fullest extent possible. It is critical to identify how students can be successful in a general education setting in order to employ best educational practices when it comes to inclusion. Although there is a developing body of research, as well as extensive legislation on record in the United States throughout the 20th and 21st centuries that can be used to inform inclusive practices, there is still a need for continued research and development in the field (Kuo, 2012; Salend, 2011).

Inclusion is a relatively new paradigm in the field of education. With the establishment of federal laws like No Child Left Behind (No Child Left Behind Act of 2001 [NCLB] 2001) and the Individuals with Disabilities Education Improvement Act (Individuals with Disabilities Education Improvement Act [IDEA] 2004), students with disabilities are entitled to free and appropriate educations in the least restrictive environment (Allen & Cowdery, 2014). “Least restrictive environment” refers to an educational placement in which a student with disabilities is
integrated into the general education setting to the fullest extent possible (Brownell et al, 2012). Educational placements are determined in accordance with a child’s educational needs and Individualized Education Plan (Salend, 2011, p. 12-13).

The philosophy of inclusion gained traction in the late 20th century in the United States, following the deinstitutionalization and normalization movements of the 1960s and 70s (Salend, 2011, p. 14-15). According to the U.S. Office of Education Programs (as cited in Roffman & Wanerman, 2011, p. 6), at that time in American history, one in five children with special needs did not receive a public education. Policies like NCLB and IDEA were developed in an effort to provide equal opportunity and education to all students regardless of ability. Research has shown the benefits of inclusion for students with disabilities, as well as students without disabilities (Salend, 2011). As such, it is crucial for continued assessment and development of inclusive education practices.

General and special educators are required to provide effective instruction to these students, and as such need to be highly qualified (NCLB, 2001). Students with special needs have a wide range of abilities and needs, across academic, social and behavioral contexts. Scientific research in inclusion should inform best practice in the classroom. The onus of determining, and ultimately ensuring, what may make a student successful in the general education classroom falls on the teacher-scientist. One important question to ask is: how can this be determined? Additionally, how can we help to ensure the success of students with disabilities in a general education inclusion setting?

**Psychology and education research.** Recent literature in the fields of education and psychology has focused mainly on school and teacher preparation, attitudes, and educational
philosophies as the most important factors for successful inclusion of students with disabilities. Positive teacher attitudes, collaborative efforts between general and special educators, and overall pedagogical approach (Fisher & Frey, 2001; Fox, Farrell, & Davis, 2004; Snyder et al, 2001; Vaz et al, 2015;) have frequently been suggested as critical to student success. Similarly, teacher training and professional development have also been identified as factors (Snyder, Garriott, & Williams-Aylor, 2001). Research has also shown that development of social skills is crucial for students entering into a general education setting (Jones & Frederickson, 2010; Williams & Reisberg, 2003). Unfortunately, these things can often be difficult to measure objectively.

There is an absence of scientific evidence in much of the current educational and psychological literature on how to identify which students can succeed in a general education setting, and why. However, a growing body of literature in the basic and applied science of Verbal Behavior Development and teaching as behavior analysis has identified various developmental cusps and specific experiences that can contribute to student preparation for and success in the general education setting.

The Verbal Behavior Development Theory (Greer & Ross, 2008; Greer & Speckman, 2010) identifies developmental cusps (Rosales-Ruiz & Baer, 1996) and cusps that are capabilities, which allow students to contact new contingencies in their environment, to increase their rate of learning, and to learn in entirely new ways than they could before. These developmental milestones, which range from basic observing responses to functional writing, are all arguably important pieces of a child’s development, and as such, are critical to his or her success in school. Most of these milestones can be identified as a newly acquired conditioned
reinforcer (Greer & Du, 2015). However, three specific cusps and capabilities have been identified through applied research as some of the biggest predictors of student success in a general education setting: (1) Naming, (2) observational learning, and (3) audience control as a function of social listener reinforcement. Verbal Behavior Development researchers have also developed interventions to aid in the acquisition of these cusps and capabilities, so that students with disabilities can be successful when they transition from self-contained into general education inclusion classrooms (Greer & Ross, 2008). These predictors are discussed in more detail later in this literature review, in the context of the Verbal Behavior Development Theory.

**Developmental Psychology and Social Pragmatic Theory**

Developmental psychology and social pragmatic theory go hand in hand when considering human development, cognition, and learning. Early educational philosophers and psychologists like John Dewey (1916) and Lev Vygotsky (1978) explored education in the context of child development and interpersonal relationships (Roffman & Wanerman, 2011). Current research in this field investigates the ontogeny of human collaboration, socialization, and thinking. “Human thinking is individual improvisation enmeshed in a sociocultural matrix” (Tomasello, 2014, p. 1). If this is true, then student learning must also be considered as “enmeshed” in a collaborative “matrix.”

**Joint intentionality.** Tomasello (2014) explored “joint intentionality” and mutual goals with common ground as a uniquely human characteristic. Joint intentionality is defined as “we” thinking; that is, the human ability to collaborate and knowingly work together to achieve a common goal. Individuals who engage in joint intentionality are able to identify common ground with other humans, and will seek to collaborate in order to achieve a mutual goal. According to
Tomasello, “Young children begin engaging with others in ways that suggest some form of joint goal from around fourteen to eighteen months of age, when they are still mostly prelinguistic” (p. 39). This suggests that by school age, joint intentionality is a crucial component of student interaction in the classroom. Research in verbal behavior development has additionally identified some of the kinds of early experiences and interventions that make this collaboration possible (Greer & Du, 2015).

There is evidence to support a certain “understanding” of collaborative activities that humans demonstrate from an early age. This understanding requires some perspective taking, as well as self-other relation awareness (p. 42). Tomasello and Hamann (2012) describe two stages that occur in the ontogenic development of collaboration in humans. The first stage involves joint attention, followed by joint goals. The second stage requires a “cognitive ability,” which typically develops around age 3, to conceptualize not only the individual’s role, but also other’s roles, in a joint activity. This understanding leads to shared motivations and joint intentionality, which extends to collaborative activities and mutual reward (p. 1).

These young children coordinate a joint goal, commit themselves to that joint goal until all get their reward, expect others to be similarly committed to the joint goal, divide the common spoils of a collaboration equally, take leave when breaking a commitment, understand their own and the partner’s role in the joint activity, and even help the partner in her role when necessary. (Tomasello, 2014, p. 41)

However, in order to operationally define these children’s behaviors, it is necessary to look past a potential “ability” or explanatory untestable source. The question of how children come to do these things remains unanswered. VBDT seeks to identify the underlying mechanism of these
collaborative behaviors, in order to determine what experiences or environmental contingencies are at play (Greer & Ross, 2008).

Hamann, Warneken, and Tomasello (2012) studied children’s commitment to a joint activity that would result in both members of a pair receiving a reward. Two children were paired up to work together to operate an apparatus that would deliver a reward. One partner received access early to the reward, but the other partner required continued engagement in the activity in order to receive his reward. Results of this study showed that children at 3.5 years of age continued to engage in the joint activity even if they received their reward early, in order to help their partner also receive their reward. The authors suggest that these actions demonstrate a joint goal and mutual understanding between the partners. Furthermore, these findings suggest that a certain level of social reinforcement is at play. That is, the children do not only engage in the activity solely in order to receive a tangible reward, but rather to contact specific social contingencies with their partner.

Similarly, Warneken, Grafenhein, and Tomasello (2012) found that toddlers between 21 and 27 months sought to engage partners in a joint activity as cooperative agents rather than “mindless social tools;” that is, these toddlers attempted to engage a partner even when they were not physically needed for the toddler to achieve a physical goal. In two experiments, toddlers were paired with an adult experimenter in a collaborative game activity. The activities were either causally unrelated, in that the game called for parallel play but did not require active collaboration between the pairs in order to engage in the activity, or causally related, in which the pair needed to work together in order to engage in the activity. The pairs engaged in the play activity, and then the activity was interrupted when the experimenter stopped engaging in the
activity for a period of 10 seconds. Participant responses under two interruption conditions, “unwilling” and “unable,” were recorded. Results showed that the participants reacted differently under each interruption condition, being more likely to attempt to re-engage the experimenter in the “unable” condition. Further, results showed that the toddlers sought to re-engage the experimenter equally across all activities, whether causally related or not.

According to his comparative psychology approach, Tomasello (2014) suggests that joint intentionality and collaboration are unique abilities that separate the human species from other primates. Indeed, there is much empirical evidence that demonstrates the differences between human children and chimpanzees when engaged in collaborative activities—primarily indicating that humans display a “we” intentionality that other animals do not (Bullinger et al, 2011; Rekers et al, 2012; Tomasello et al, 2005; Warneken et al, 2006). Although cooperative behavior has been studied in other species including bees, ants, wolves, and chimpanzees, Tomasello (2014a) highlights the differences in human collaborative behavior from an evolutionary perspective. Tomasello posits that this collaboration is “based in some special psychological mechanisms—both cognitive and motivational—that have evolved to support humans’ ultra-cooperative lifestyles” (2014a, p.187). The source for this “species unique motivation for collaboration” (Tomasello, 2014, p. 41) can be linked to reinforcement for collaboration as defined in the present study.

**A Behavior Analytic Approach**

Joint intentionality and collaboration as defined in comparative developmental psychology are uniquely human qualities. However, there is a lack of evidence as to the source of these qualities or behaviors. While Tomasello (2014) identifies certain developmental
milestones that occur in human development, he does not identify the specific experiences that contribute to this development. In the analysis of verbal behavior, these psychological constructs are defined operationally in terms of form and function of a behavior. This different perspective suggests that the sources of development can be found in an individual’s experiential history and reinforcement (Greer & Du, 2015). Furthermore, the function of human behavior and language are defined in terms of both their structure (what the behavior looks like) and their function (their consequences).

Verbal behavior is social behavior (Skinner, 1957). As such, social reinforcement can be thought of as a foundational component of verbal behavior development. In the context of education, it is critical to understand how social reinforcement can impact student performance and learning. In the average primary school classroom in America, students are required to learn in a group of approximately 26 students (National Center for Education Statistics, 2012), with class sizes reaching up to 35 in some places. As such, social reinforcement comes into play for students at every turn. Whether learning academic skills, navigating self-management expectations, or developing social skills, students in a large group of peers will be at a distinct disadvantage if social reinforcement does not function to shape their behavior and motivation for collaboration in the classroom (Eby & Greer, 2017; Schmelzkopf et al, 2017). However, the specific role of social reinforcement in the classroom has been largely overlooked in the behavior analytic literature. In order to understand the role of social reinforcement and collaboration in the classroom, it is important to consider the conceptual underpinnings of conditioned reinforcement in general.

**Conditioned reinforcement.** The principle of conditioned reinforcement was
established in early behavior analytic and psychological research as an important topic to study in order to understand the function of human behavior. There is an extensive body of research that identifies the role of conditioned reinforcement in human social behavior (Williams, 1994). Skinner (1953) and Keller and Schoenfeld (1950) pointed to conditioned reinforcement as the key to understanding complex human behavior.

Conditioned reinforcement occurs when a neutral stimulus, or a stimulus that does not reinforce certain behaviors, acquires reinforcing properties after being paired with an existing primary (unconditioned) or secondary (conditioned) reinforcer. From a radical behaviorist standpoint, behavior is selected by its consequences and is an extension of natural selection (Skinner, 1957; 1986). The establishment of conditioned reinforcers can be critical to behavioral selection and shaping. The Verbal Behavior Development Theory (Greer & Du, 2015; Greer & Keohane, 2005; Greer & Ross, 2008; Greer & Speckman, 2009) identifies conditioned reinforcers that are important components of language development, learning, and behavior.

Kelleher and Gollub (1962) presented a review of experiments that investigated positive conditioned reinforcement. In these experiments, the researchers tested various chains of schedules in order to determine how conditioned reinforcers are established. These experiments led Kelleher and Gollub to ask three important questions about conditioned reinforcement: (1) what conditions result in the component stimuli of chained schedules reinforcement becoming conditioned reinforcers, (2) what variables affect the strength of the reinforcer and (3) how can conditioned reinforcers be utilized to prolong responding or generate responding. Kelleher and Gollub stated that any stimulus could become a conditioned reinforcer, but the strength of the reinforcer was directly related to the immediacy in which the pairing occurred.
Fantino (2008) also presented a review of several experiments that were seminal to the research on conditioned reinforcement. Fantino described conditioned reinforcement in relation to the concept of choice, and how these two things go hand in hand in psychology and in a study of human behavior (Greer, 1982; Eby & Greer, 2017; Schmelzkopf et al, 2017). He focused on the context and relative value of conditioned reinforcers, and concluded that only stimuli related to a reduction in time to primary reinforcement or increase in reinforcement value are true conditioned reinforcers. He also concluded that conditioned reinforcers do impact preference.

The basic behavioral principle of reinforcement can be defined as when an immediate consequence results in an increase in the frequency of a particular behavior. If behavior is selected out by consequences, then reinforcement is crucial to the establishment and maintenance of certain behaviors (Greer, 2008). Skinner (1957) defined verbal behavior as operant behavior. Therefore, the establishment and expansion of a community of conditioned reinforcers can contribute to the development of increasingly complex social, verbal behaviors. Theoretical and applied research findings in verbal behavior development suggest that certain interventions can improve the “educational and social prognosis” for children by establishing new reinforcers (Greer & Du, 2015).

The Verbal Behavior Development Theory (Greer & Keohane, 2005; Greer & Ross, 2008; Greer & Speckman, 2009) expanded upon Skinner’s work, and identified verbal behavior cusps (Rosales-Ruiz & Baer, 1996) and capabilities (Greer & Ross, 2008; Greer & Speckman, 2009) that are acquired throughout a child’s developmental trajectory. These cusps allow children to contact new contingencies in their environment, and capabilities allow children to learn in new ways.
A body of research has been conducted that suggests that these developmental cusps and capabilities arise as a function of the establishment of new conditioned reinforcers, most of which are social in nature. These new conditioned reinforcers are the foundations for the emergence of new verbal cusps and capabilities (Greer & Du, 2015). Many of these are associated with observing or orienting behavior that are operant responses (Holland, 1958). These include conditioned reinforcement for observing 2D and 3D stimuli (Greer & Han, 2014; Pereira-Delgado, Greer, Speckman & Goswami, 2008), conditioned reinforcement for observing faces (Maffei, Singer-Dudek, & Keohane, 2014), conditioned reinforcement for listening to voices (Choi & Greer, 2014; Greer, Pistoljevic, Cahill & Du, 2011), conditioned reinforcement for seeing and doing that results in generalized motor imitation (Du & Greer, 2014), conditioned reinforcement for observing books (Buttigieg, 2015; Tsai & Greer, 2006) and conditioned reinforcement for writing (Lee, 2016). The recent body of research in the Verbal Behavior Developmental Theory suggests that conditioned reinforcement for these observing responses may be necessary in order for 2D and 3D stimuli, faces, and voices, see-do correspondence, and book stimuli to select out truly verbal behavior.

Arthur Staats, in his paradigmatic or psychological behaviorism, built upon Watson’s behaviorism and Skinner’s radical behaviorism, and called for a “unification” of all of the different psychological paradigms in a behavioral way (Staats, 1999). Staats placed an emphasis on an individual’s prior learning on his behavior, as well as the social context of his behavior. According to Staats, a stimulus that is conditioned as a reinforcer will simultaneously elicit a motor and emotional response, and contact with these stimuli result in certain social responses (Staats, 2006).
Donahoe and Palmer’s work (1994) suggested that humans are equipped with the neurobiological mechanisms that allow for them to acquire operant and respondent relations following contact with their environment. They conducted research with infants as young as 10 days old and found that they blinked in response to a tone that was immediately followed by a puff of air in the eye. As the tone was paired with the air puff, infants began blinking at the onset of the tone. Similarly, infants learned to manipulate a mobile by kicking their right leg, resulting in increased right leg kicks, and decreased left leg kicks. Donahoe and Palmer suggest that in normal human development, individuals have the neurobiological mechanisms required to acquire operant and respondent relations, which can lead to increased contact with the environment, acquisition of conditioned reinforcers, and more complex social behavior.

Fantino (2008) and Williams (1994) cited studies by Wyckoff (1952, 1969) which suggested that organisms including pigeons, rats, monkeys, fish, and humans will observe stimuli even if they do not change the scheduled rate of primary reinforcement. Fantino described the conditioned reinforcement hypothesis of observing, which states that observing is maintained by the production of a stimulus that has previously been paired with positive reinforcement.

Conditioned reinforcers can maintain observing responses, and recent research in social learning has shown that conditioned reinforcers can also be acquired through observation. Greer and Singer-Dudek (2008) tested the effects of an observational procedure on the emergence of conditioned reinforcement for previously neutral stimuli including a plastic disc and small piece of string. In this study, the previously neutral stimuli functioned to reinforce both performance and learning behaviors after the intervention in which preschool participants were denied access to the reinforcers and observed their peers receiving reinforcement. Further research on the
conditioned reinforcement through observation supports Greer and Singer-Dudek’s findings, including the acquisition of conditioned reinforcement for more neutral stimuli such as strings and washers (Greer, Singer-Dudek, & Schmeltzkopf, 2008), academic tasks such as math and writing (Lee, 2016; O’Rourke, 2011) and adult approvals or learned social reinforcers (Eby & Greer, 2017; Greer, Dudek, Longano & Zrinzo, 2008).

**Group contingencies.** In the early literature, group contingencies were explored as a way to control aberrant behaviors. Over time there has been a resurgence of the use of class-wide positive behavior supports to aid with classroom management (Theodore, Bray, & Kehle 2004). Tactics including class-wide token economies, point systems (Greer, 2002), and the good behavior game (Barrish, Saunders, & Wolf, 1969) have been found to be effective tools of classroom management.

Litow and Pumroy (1975) identified three kinds of group contingencies that can be utilized: (1) independent, (2) interdependent, and (3) dependent contingencies. Independent group contingencies require the same responses, criteria, and reinforcers for the whole group, but reinforcement is delivered to each individual based on their own performance. Interdependent group contingencies require the whole group to attain a specific goal, and the same reinforcement is delivered to the whole group. Dependent contingencies allow for a whole group to receive reinforcement dependent on an individual or small subset achieving a specific criteria.

Group contingencies function on the basic behavioral principle of positive reinforcement, but as they are applied to a group (one or more) of students, individual students’ conditioned reinforcement, especially for collaboration, plays an important part in the efficacy of these contingencies.
**Verbal Behavior Development Theory.** Conditioned reinforcers are particularly important for addressing applied problems because of their utility in theoretically explaining the ontogenetic selection of behaviors, particularly verbal behavior (Greer, 2008). The Verbal Behavior Development Theory (VBDT) (Greer & Ross, 2008; Greer & Speckman, 2009) builds on Skinner’s *Verbal Behavior* (1957) as well as previous research on derived relations (Hayes, Barnes-Holmes & Roche, 2001; Sidman, 1971). The theory has been developed in conjunction with empirically tested studies to suggest a possible developmental trajectory of behavioral cusps and cusps that are capabilities, which arise as a function of contact with conditioned reinforcers in an individual’s environment.

Verbal behavior developmental cusps allow children to contact new contingencies in their environment (Greer & Ross, 2008; Rosales-Ruiz & Baer, 1996). Cusps that are also capabilities allow children to learn in new ways that they couldn’t before (Greer & Ross, 2008). Over the last 30 years, VBDT researchers have identified ways to determine if a child has a certain cusp or capability in his behavioral repertoire, as well as effective interventions to induce these cusps when they are missing (Greer & Keohane, 2005; Greer & Speckman, 2009). The developmental trajectory spans behaviors in listener, speaker, reader, and writer repertoires. Through basic, applied, and translational research, VBDT researchers have also identified the ways that these developmental milestones impact a child’s overall performance and learning in school.

*The Comprehensive Application of Behavior Analysis to Schooling.* In the Comprehensive Application of Behavior Analysis to Schooling (CABAS®) educational model (Casarini, Catavelli & Cavallini, 2011; Greer, Keohane & Healy, 2002; Lamm & Greer 1991;
Selinske, Greer & Lodhi, 1991; Singer-Dudek, Speckman & Nuzzolo, 2010), the Verbal Behavior Development Theory is put into practice. CABAS® is a cybernetic system that connects parents, teachers, and a University component to create an effective learning program for all of the students who are at the heart of the system (Greer, 2002). In the CABAS® model, teachers are trained in situ to be strategic scientists, and all student learning is measured and analyzed on a moment-to-moment basis. The basic unit of instruction in all CABAS® classrooms is the learn unit (Albers & Greer, 1991; Greer, 2002; Greer & McDonough, 1999). The learn unit is an interlocking three-term contingency wherein the teacher presents an antecedent, the student is given an opportunity to respond, and the teacher provides immediate feedback in the form of reinforcement or correction based on the student’s response. Learn units have been found to be a measure of effective instruction, and a “necessary if not sufficient ingredient for teaching” (Albers & Greer, 1991). The learn unit has also been found to be a predictor of educational outcomes in the classroom (Bahadourian & Greer, 2005; Bahadourian, Tam, Greer, & Rousseau, 2006).

The CABAS® method of inclusion can be found in its Accelerated Independent Learner (AIL) classrooms (Greer, 2002). In AIL classrooms, students with and without disabilities receive individualized instruction through the learn unit. As a result of the research in verbal behavior development that has come out of CABAS® classrooms, four cusps and cusps that are capabilities have been identified as the most critical for students to have in order for them to be successful in a general education setting (Greer, 2002; Greer & Ross 2008). (1) Naming, (2) observational learning, (3) audience control and (4) transformation of stimulus function across saying and writing, have been identified as being developmentally necessary for students to
contact all of the contingencies in a general education setting like the AIL classroom. The first three of these cusps and capabilities are especially relevant to the present study.

**Naming.** Naming (Horne & Lowe, 1996) is a cusp that is also a capability. Skinner (1957) described listener and speaker repertoires that develop independently of each other at first. Naming can be described as the joining of the listener and speaker within the skin (Greer & Ross, 2008). When a child has Naming, he is able to acquire language incidentally, without direct instruction. As evidenced by the longitudinal language study implemented by Hart and Risley (1995), children learn millions of words throughout their development. It would be impossible for a child to be taught each word individually in a school setting. Thus, Naming is an important developmental phenomenon that allows children to contact new contingencies in their environment and learn in new ways. Greer, Corwin, and Buttigieg (2011) found that the emergence of Naming not only increased students’ rate of learning, but allowed them to learn from a model demonstration learn unit. Hranchuk (2016) also found that students with Naming actually learned more efficiently from model demonstration learn units than standard instruction. Students need to be able to learn through a teacher model, particularly in a general education setting.

Naming emerges around the age of 2-3 years for typically developing children, but for children with disabilities, it may need to be induced (Greer & Ross, 2008). Multiple exemplar instruction across listener and speaker responses has been identified as a tactic to induce Naming in students who do not previously demonstrate it (Fiorile & Greer, 2007; Gilic & Greer, 2011; Greer, Corwin, & Buttigieg, 2011; Greer, Stolfi, Chavez-Brown, & Rivera-Valdes, 2005; Greer, Stolfi, & Pistoljevic, 2007). Auditory matching (Choi, 2012; Greer, Speckman-Collins & Park,
2007) and intensive tact instruction (Pistoljevic, 2008) have also been identified as protocols to induce Naming. As such these interventions can be implemented for students with disabilities, so that they might acquire Naming prior to entering a general education setting.

**Observational learning.** The observational learning capability is essential to successful inclusion for students with disabilities. Students who have the observational learning capability are able to learn by watching another student perform and contact environmental contingencies (Greer, Singer-Dudek & Gautreaux, 2006; Catania, 2007; Greer & Dudek, 2008; Pereira-Delgado & Greer, 2009; Dudek & Oblak 2013). Observational learning is critical to student success in school, as much of what is taught in general education is done so in a large group setting. Students must be able to learn not just through direct instruction, but also by observing their classmates. A teacher in a general education setting cannot possibly deliver a direct consequence to every student for every learn unit presented throughout the day. Students who can learn by observing a peer receive a consequence can learn more effectively and in a more time efficient manner.

Observational learning has been studied over many years in various epistemologies, including social learning theory and behavior analysis (Bandura, Grusec, & Menlove, 1966; Bandura & Jeffrey, 1973; Bandura & McClelland, 1977; Deguchi, 1984; Guerin, 1997; Greer, Singer-Dudek, & Gautreaux, 2006; Catania, 2007; Fryling, Johnston, & Hayes, 2011). It can be defined simply as learning through observation; that is, humans, along with some non-human species (Tomasello, 2008), have demonstrated the ability to learn by watching another subject perform and contact environmental contingencies. Whether this phenomenon occurs at the cognitive level as a result of symbolic coding (Bandura, 1966, 1977) or as a result of
environmental contingencies, it is widely acknowledged that observational learning is a critical piece of social development. However, Greer, Singer-Dudek, and Gautreaux (2006) emphasize the important distinction between observational learning as a developmental capability and widely used psychological terms like imitation, modeling, copying, and social learning. In this paper, observational learning refers specifically to the verbal behavior developmental capability that allows an individual to learn in a way that he could not previously.

*Three kinds of observational learning.* To date, three different kinds of observational learning have been identified: (1) observational learning of performance behaviors (Greer, Singer-Dudek & Gautreaux, 2006; Deguchi, 1984; Bandura & McClelland, 1977), (2) observational learning that leads to the acquisition of new operants (Greer & Ross, 2008; Pereira-Delgado & Greer, 2009), and (3) acquisition of conditioned reinforcers through observation (Greer & Dudek, 2008; Dudek & Oblak, 2013). The observational learning capability is critical to student success in schools, as much of what is taught in general education is in a large group setting.

*Interventions to induce observational learning.* The acquisition of observational learning is clearly an important developmental milestone that leads to new ways of learning. Students with disabilities often do not demonstrate this capability, and thus require intervention to induce it. Several different interventions, including peer monitoring, peer tutoring, and peer-yoked contingency game boards, have been empirically tested and shown effective in inducing observational learning in students who do not demonstrate it. Therefore, it can be deduced that reinforcement for collaboration with a peer may be an important component or possibly a prerequisite for this vital capability.
Gautreaux (2005) and Delgado and Greer (2009) found that elementary and middle school aged children acquired the observational learning capability following a peer monitoring procedure. In these procedures, target participants were taught to monitor their peers while they received instruction. The target participants observed their peer respond to instruction and receive consequences that involved reinforcement for correct responses and corrections for incorrect responses. Both studies found that the target participants acquired observational learning more quickly by observing their peers receive corrections (Greer et al, 2006).

Peer tutoring, a classroom tactic in which one student delivers instruction to another student, has also been found to induce observational learning. Gautreaux (2005) found that a peer monitoring training procedure increased the observational repertoires of all participants who engaged in peer tutoring. Additionally, Greer, Keohane, Meincke, Gautreaux, Pereira, Chavez-Brown, and Yuan (2004) demonstrated that peer-tutoring procedures resulted in the emergence of observational learning for both peer tutors and tutees. The tutoring process is inherently collaborative, and requires both participants to work together to achieve their common goal.

The peer-yoked contingency game board, which will be described in further depth later in this review, has also been identified as an effective intervention to induce observational learning repertoires (Davies-Lackey, 2005; Hawkins, Charnock & Gautreaux, 2007; Rothstein & Gautreaux, 2007; Stolfi, 2005). In these studies, a target student was paired with a peer confederate. The target student observed the peer being taught something new, and the target participant was then required to emit the new operant in order for the pair to receive reinforcement. Following the intervention, participants who did not previously demonstrate an observational learning repertoire acquired this capability.
Walsh (2009) implemented an observational system of instruction (OSI) that combined peer monitoring, peer tutoring, and a peer-yoked contingency game board. This intervention resulted in the emergence of observational learning, as well as increased vocal verbal operants, correct responses to observed instruction and untaught naming responses, and decreased disapprovals emitted by participants.

Each of these interventions require a certain level of collaboration between target participants and their peers. The source of reinforcement in these interactions still remains to be identified and investigated experimentally.

Recent findings on observational learning and social reinforcement. In all of the aforementioned studies, the presence of a peer was necessary to implement the intervention to induce observational learning. As such, it can be suggested that the presence of a peer, and social reinforcement for that peer, is integral in the acquisition of observational learning. Recent research on observational learning has expanded on the findings of Greer, Singer-Dudek and Gautreaux (2006), and sought to further investigate the role of peer presence on the induction of this important verbal behavior developmental capability.

Gold (2013) tested the effects of a peer-yoked contingency game board on the acquisition of observational learning of performance behavior, observational learning of new operants, and the acquisition of Naming. Following the implementation of the peer-yoked contingency game board intervention, participants acquired these capabilities. Gold also compared the intervention as it was implemented with a peer present, as well as without a peer present. As such, she was able to isolate the social component of the yoked contingency. Results showed that peer presence was a necessary component of the observational intervention. Similarly,
Vassare (2017) found that a peer monitoring procedure was only effective in inducing the observational learning capability when a peer was present in-vivo, and not when monitoring a peer through video observation.

Byers (2016) expanded on Gold’s study and analyzed the relationship between preschoolers’ attention to peers and their observational learning repertoires. Byers found that peer attention was a necessary prerequisite for students to have before they could acquire observational learning. The peer-yoked contingency game board was only successful as an intervention to induce observational learning for students who demonstrated peer attention prior to the onset of the experiment.

Furthermore, Baowaidan (2016) tested an observational procedure on audience awareness and the emission of audience appropriate behavior by preschool students. Prior to intervention, participants demonstrated very few or no observing responses in the presence of peers, and did not engage in appropriate social interactions with their peers throughout the day. Target participants observed a peer confederate receive reinforcement in the form of neutral stimuli for performance tasks, while the target participants were denied the reinforcer. The procedure continued until the target participant achieved criterion, which was defined as requesting or attempting to access the reinforcer that their peer confederate was receiving across two intervention sessions. Results showed that peer observing responses and audience appropriate behaviors in social settings increased for 8 out of 9 participants after the intervention was implemented.

These recent findings demonstrate the importance of both peer presence and engaging in observing responses of a peer in observational interventions. Additionally, these findings raise
questions about the source of reinforcement for these observing responses, as well as the role of reinforcement for collaboration in peer interactions and observations. While the social component of the yoked contingency has been identified and isolated in these experiments, the actual collaborative (yoked) nature of the contingency and its source has not been investigated.

**Audience control and social listener reinforcement.** A third predictor of inclusion success for students with disabilities is audience control as a function of social listener reinforcement (Baker, 2014; Reilly-Lawson & Walsh, 2007; Sterkin, 2012). Students with social listener reinforcement and audience control engage in meaningful and appropriate social interactions, and do not emit inappropriate or socially unacceptable vocal verbal operants or behaviors when in the presence of their peers. For students with disabilities, social listener reinforcement can help them to develop relationships with their peers in the general education setting, and can also increase their motivation to learn and perform in a large group.

Skinner (1957) described how the audience functions to control a speaker’s verbal behavior. “An audience, then, is a discriminative stimulus in the presence of which verbal behavior is characteristically reinforced and in the presence of which, therefore, it is characteristically strong” (Skinner, 1957, p. 172). When an individual demonstrates audience control, he will emit different verbal responses in the presence of different audiences. For example, a student with audience control would emit different verbal behavior in the presence of a teacher than in the presence of his peers.

**Peer-yoked contingencies.** A peer-yoked contingency (Greer & Ross, 2008) can be defined as a reinforcement condition in which one or more individual’s reinforcement is “yoked,” that is, coupled or attached, to another’s. One way that a yoked-contingency can be
facilitated is through the use of a game board. The Social Listener Reinforcement (SLR) Protocol has been developed as a systematic way to teach social skills, while pairing appropriate peer interactions with reinforcement (Reilly-Lawson & Walsh, 2007; Sterkin, 2012). A peer-yoked contingency game board (Davies-Lackey, 2005; Stolfi, 2005) is used in this intervention so that students must collaborate to receive reinforcement together. The peer-yoked contingency game board consists of two sides with an equal number of spaces to move to the finish line, where a backup reinforcer can then be accessed. On one side, a group of two or more students are partnered and working together to emit correct responses in order to move up on the game board and reach the finish line. On the other side, a teacher can move forward toward the finish line if the students emit incorrect responses.

Stolfi (2005) and Davies-Lackey (2005) each tested the effects of a peer-yoked contingency on the acquisition of observational learning repertoires by children with developmental disabilities. Both studies found that establishing a need for collaboration through the use of the yoked contingency game board was an effective tactic to induce observational learning in children who did not previously demonstrate this capability. Their seminal works provide a basis for the use of a peer-yoked contingency in classrooms to induce observational learning and social listener reinforcement.

Sterkin (2012) and Baker (2014) also utilized a peer-yoked contingency game board as part of a social listener reinforcement protocol that resulted in increased vocal verbal operants and decreased the stereotypy emitted by children with developmental disabilities. Their studies further demonstrate how reinforcement for collaboration can be an influential tool used to effect student learning and social behavior.
The aforementioned studies all tested the effects of the peer-yoked contingency on other repertoires and suggest that it is an educationally significant tactic. However, there is a dearth of research on the source of reinforcement—reinforcement for collaboration—and where it fits in to a developmental trajectory. The present study is a functional analysis of how reinforcement for collaboration affects rate of learning.

Peer tutoring. Greer et al (2004) provide an in depth analysis of the educational significance of peer tutoring, a collaborative activity, in the classroom. According to the authors “tutoring is one of the most researched and effective pedagogical tactics in both the educational and psychological literature” (p. 295). Research has shown that peer-tutoring programs benefit participants who are both tutors, those who present instruction, and tutees, those who receive instruction. Benefits include the acquisition of new academic skills (Gautreaux, 2005), emergence of observational learning (Delgado & Greer, 2009), and increase in social interactions for both the tutor and tutee (Greer & Polirstok, 1982; Lawson & Trapenberg, 2007). Peer tutoring has also been found to increase “engaged academic time” (Greer et al 2004, p. 297) in classrooms. Studies comparing peer-delivered instruction to teacher-delivered instruction show that peer-delivered is more effective (Greer et al, 2004).

Peer tutoring is inherently collaborative in nature. Students must engage with one another in order to teach and/or learn their targeted responses. Accordingly, it may contribute to the development of conditioned reinforcement for collaboration in individuals who do not demonstrate it.

Conclusion

A review of the literature across educational practices, comparative developmental
psychology, and behavior analysis suggests that reinforcement for collaboration may actually be a verbal behavior developmental cusp that allows an individual to contact new social contingencies in his environment.

**Social contract vs. social contact.** It is important to note a distinction in the source of reinforcement for collaborative behavior (Eby & Greer, 2017). That is, when involved in collaborative activities, are individuals engaging for the purposes of a social *contract* or for the purposes of social *contact* (Greer & Du, 2015)? This distinction may denote an individual who has reinforcement for collaboration as compared to an individual who does not.

In social *contract* behavior (i.e. I’ll do this if you do that), individuals engage in a behavior together so that they might receive individual reinforcement. In social *contact* behavior (i.e. Let’s work together because it is mutually reinforcing to do so), reinforcement shifts from an externally motivating reinforcer to the social reinforcer of collaborating with another person. Social contact can be measured by the emission of vocal verbal operants, social interactions, and positive or negative behavior directed at the collaborative partner. While the topography of behaviors may appear to be the same in both social contract and social contact behavior (i.e. working together to achieve a common reinforcer), the function of the behavior for someone who has reinforcement for collaboration will be in the collaboration itself.

**Rationale and educational significance.** Based on the wide range of literature that points to the importance of collaboration and social reinforcement in human development, it is necessary to explore these ideas in the context of learning, so that educators and practitioners might utilize this information in a productive way to allow for more efficient and effective instruction. There is a need for more research on the role of social reinforcement, specifically
reinforcement for collaboration with peers, in the classroom. In this study I sought to identify reinforcement for collaboration as a potential developmental cusp that may contribute to faster learning and increased social contact through the emission of vocal verbal operants. Additionally, I looked to establish this cusp in students who do not demonstrate it, so that they might be better prepared to learn in a group and ultimately, be successful in a general education classroom.

Research questions. In this study, I investigated reinforcement for collaboration. In Experiment I, I sought to identify the presence or absence of reinforcement for collaboration with a peer in elementary school aged children, and to determine the effects of a collaborative contingency on rate of learning. In Experiment II, I implemented a collaborative intervention in an effort to establish reinforcement for collaboration in students who did not demonstrate it. The main research questions I investigated were: 1) is reinforcement for collaboration a developmental cusp that allows students to contact new contingencies in their environment? 2) If so, can we induce it when it is missing?

In order to determine if reinforcement for collaboration is indeed a developmental cusp, differences in participant rate of learning and vocal verbal operant emission under a collaborative condition were compared. If participants learned faster and emitted higher number of vocal verbal operants under the collaborative reinforcement condition, it could be said that they demonstrated reinforcement for collaboration. As such, conclusions could be drawn about the nature of reinforcement for collaboration as a developmental cusp. Participants who were identified as not demonstrating reinforcement for collaboration were then placed into a collaborative intervention, in order to determine if this cusp could be induced.
Chapter II

EXPERIMENT I: THE EFFECTS OF A COLLABORATIVE CONTINGENCY ON RATE OF LEARNING

Method

Participants

Twelve participants were selected for this study from a Title I public elementary school. The school was located in a suburban area of a large metropolitan city and consisted of a highly diverse--culturally and socio-economically--student body in grades kindergarten through 2nd grade. Participants were separated into dyads by class. That is, after participants were selected, they were paired with another participant who had been identified in their classroom. This was done in order to minimize the amount of disruption to participants’ school day.

Two dyads (4 participants) consisting of 6 year olds who were not educationally classified as having a disability were selected from a 1st Grade CABAS® Accelerated Independent Learner (AIL) class. One dyad (two participants) consisting of 7 year olds who were not educationally classified as having a disability, was selected from a 2nd Grade CABAS® AIL class. Two dyads consisting of students with IEPs were selected from a Kindergarten CABAS® AIL class, and one dyad consisting of students with IEPs was selected from a CABAS® self-contained classroom. The participants from the self-contained classroom were in kindergarten and 1st grade.

These participants were selected because they demonstrated most of the necessary AIL cusps and capabilities, and were close to being on grade level across academic subjects. Additionally, participants were identified as learning at an average rate based on their teacher
assessments and relative performance compared to peers in their respective grades.

In total, six typically developing (not educationally classified as having a disability) participants and six participants who had an educational classification of Autism Spectrum Disorder or “Other Health Impaired” were included in the study. Five out of 12 participants qualified for free or reduced lunch based on socio-economic status. A comprehensive description of the demographics and developmental cusps/capabilities that each student had in repertoire at the time of the study is outlined in Table 1.
Table 1

Participant Demographics and Verbal Behavior Developmental Levels for Experiment I

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age/Grade</th>
<th>Gender</th>
<th>Level of Verbal Behavior</th>
<th>DRA Score (Beginning of Year)</th>
<th>Math Grade Level</th>
<th>Relevant Casps and Capabilities</th>
<th>Free/Reduced Lunch?</th>
<th>Educational Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 1</td>
<td>7.8/2nd</td>
<td>F</td>
<td>Listener/Reader/Writer</td>
<td>14 (slightly below)</td>
<td>on</td>
<td>Naming, OL, TSF, SLR</td>
<td>Yes</td>
<td>None</td>
</tr>
<tr>
<td>Participant 2</td>
<td>7.3/2nd</td>
<td>M</td>
<td>Listener/Reader/Writer</td>
<td>14 (slightly below)</td>
<td>on</td>
<td>Naming, OL, TSF, SLR</td>
<td>Yes</td>
<td>None</td>
</tr>
<tr>
<td>Participant 3</td>
<td>6.8/1st</td>
<td>F</td>
<td>Listener/Reader/Writer</td>
<td>8 (above)</td>
<td>on</td>
<td>Naming, OL, TSF, SLR</td>
<td>Yes</td>
<td>None</td>
</tr>
<tr>
<td>Participant 4</td>
<td>6.5/1st</td>
<td>M</td>
<td>Listener/Reader/Writer</td>
<td>4 (on)</td>
<td>on</td>
<td>Naming, OL, TSF, SLR</td>
<td>Yes</td>
<td>None</td>
</tr>
<tr>
<td>Participant 5</td>
<td>6.9/1st</td>
<td>M</td>
<td>Listener/Reader/Writer</td>
<td>8 (above)</td>
<td>on</td>
<td>Naming, OL, TSF</td>
<td>No</td>
<td>Autism</td>
</tr>
<tr>
<td>Participant 6</td>
<td>6.0/K</td>
<td>F</td>
<td>Listener/Reader/Writer</td>
<td>3 (above)</td>
<td>on</td>
<td>Naming, OL, TSF</td>
<td>Yes</td>
<td>Autism</td>
</tr>
<tr>
<td>Participant 7</td>
<td>6.9/1st</td>
<td>M</td>
<td>Listener/Reader/Writer</td>
<td>4 (on)</td>
<td>on</td>
<td>Naming, OL, TSF</td>
<td>No</td>
<td>None</td>
</tr>
<tr>
<td>Participant 8</td>
<td>6.8/1st</td>
<td>F</td>
<td>Listener/Reader/Writer</td>
<td>3 (slightly below)</td>
<td>on</td>
<td>Naming, OL, SLR</td>
<td>No</td>
<td>None</td>
</tr>
<tr>
<td>Participant 9</td>
<td>6.0/K</td>
<td>M</td>
<td>Listener/Reader/Writer</td>
<td>n/a*</td>
<td>above</td>
<td>Naming, OL, TSF, SLR</td>
<td>No</td>
<td>Autism</td>
</tr>
<tr>
<td>Participant 10</td>
<td>5.5/K</td>
<td>F</td>
<td>Listener/Speaker</td>
<td>n/a*</td>
<td>Slightly below</td>
<td>Listener Half of Naming, CR Voices</td>
<td>No</td>
<td>Other Health Impaired</td>
</tr>
<tr>
<td>Participant 11</td>
<td>6.0/K</td>
<td>M</td>
<td>Listener/Speaker</td>
<td>n/a*</td>
<td>above</td>
<td>Naming, OL, SLR</td>
<td>No</td>
<td>Other Health Impaired</td>
</tr>
<tr>
<td>Participant 12</td>
<td>5.9/K</td>
<td>F</td>
<td>Listener/Speaker</td>
<td>n/a*</td>
<td>Slightly below</td>
<td>Naming, OL, SLR</td>
<td>No</td>
<td>English Language Learner (no IEP)</td>
</tr>
</tbody>
</table>

Note: DRA refers to the Developmental Reading Assessment (Beaver & Carter, 2006), an assessment designed to assess reading fluency and comprehension. Scores are assigned in intervals of 2 (i.e. 4, 6, 8). A DRA score of 16 is expected at the beginning of 2nd grade, and of 6 is expected at the beginning of 1st grade. *The assessment is not administered to Kindergarten students at the beginning of the school year.
### Table 2

**Diagnostic information and standardized scores for educationally classified participants.**

<table>
<thead>
<tr>
<th>Participant</th>
<th>Educational Classification</th>
<th>Medical Diagnosis/DSM-V Code*</th>
<th>Full Scale IQ score^</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 5</td>
<td>Autistic</td>
<td>Autism Spectrum Disorder (299.0)</td>
<td>92</td>
</tr>
<tr>
<td>Participant 6</td>
<td>Autistic</td>
<td>Autism Spectrum Disorder (299.0)</td>
<td>96</td>
</tr>
<tr>
<td>Participant 9</td>
<td>Autistic</td>
<td>Autism Spectrum Disorder (299.0)</td>
<td>93</td>
</tr>
<tr>
<td>Participant 10</td>
<td>Other Health Impaired</td>
<td>Developmental Language Disorder (315.1)</td>
<td>n/a</td>
</tr>
<tr>
<td>Participant 11</td>
<td>Other Health Impaired</td>
<td>Microcephaly (742.1) ADHD (314.01) ODD (313.81) Generalized Anxiety Disorder(300.02)</td>
<td>n/a</td>
</tr>
<tr>
<td>Participant 12</td>
<td>Communication Impaired</td>
<td>none</td>
<td>n/a</td>
</tr>
</tbody>
</table>

*Note: *Medical diagnoses were performed and reported by neurologists and/or developmental pediatricians, as reported upon placement in school. DSM-V codes reflect the diagnosis from the medical professional, who may have used multiple assessments to arrive at diagnosis. ^Full-scale IQ scores were obtained from the Wechsler Intelligence Scale (WISC-V) or Wechsler Preschool and Primary Scale of Intelligence (WPPSI-4). These scores were only readily available for participants who had received an educational evaluation at the time of the study.

### Setting

This experiment was conducted in each dyad’s respective classroom. The AIL classrooms consisted of one teacher, two teaching assistants, and approximately 20 children each. The self-contained classroom consisted of 1 teacher, 4 teaching assistants, and 8 students. Participants sat with the experimenter at a table in the back of the classroom, or in a small vestibule directly outside of the classroom door to minimize distraction. Participants and the
experimenter sat in child-sized chairs that were available in the classrooms. In the yoked and individual conditions, dyads were seated next to each other and across from the experimenter who held the computer in front of them.

Materials

The materials utilized in this study consisted of a laptop computer, a pre-made data sheet, black pens, and a peer-yoked contingency game board. Various sets of music symbol stimuli were created using Microsoft PowerPoint® and presented to participants on the computer. Each set consisted of 5 symbols, presented 4 different times with multiple exemplars, for a total of 20 stimuli in each set. Symbols were selected from *The Unicode Standard, Version 9.0* (2016) list of music symbols and names. Stimuli were assigned to each set based on number of syllables in name and basic visual differences, to control for ambiguous or unbalanced stimuli. Music symbols were selected as target stimuli because none of the participants had previous exposure to them. Table 2 lists each set and the target stimuli it included.

The peer-yoked contingency game board was created with the participants’ interests in mind, and featured characters from a popular children’s movie. The board was designed on a computer, and printed in color on an enlarged paper sized 11 x 17 inches. It was laminated and hung directly in front of participants during the experiment. Figure 1 shows an example of the yoked contingency game board utilized during this experiment.
Table 3

*Music symbol stimuli taught to participants across varying conditions in Experiment I*

<table>
<thead>
<tr>
<th>Set 1</th>
<th>Set 2</th>
<th>Set 3</th>
<th>Set 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Half Note</td>
<td>Flat</td>
<td>Bass Clef</td>
<td>Treble Clef</td>
</tr>
<tr>
<td>Quarter Rest</td>
<td>Repeat</td>
<td>Triplet</td>
<td>Whole Note</td>
</tr>
<tr>
<td>Segno</td>
<td>16th Rest</td>
<td>Eight Note</td>
<td>Half Rest</td>
</tr>
<tr>
<td>Crescendo</td>
<td>Dotted Quarter</td>
<td>Tie</td>
<td>Sharp</td>
</tr>
<tr>
<td>Pause</td>
<td>Mordent</td>
<td>Natural</td>
<td>Coda</td>
</tr>
<tr>
<td><strong>Set 5</strong></td>
<td><strong>Set 6</strong></td>
<td><strong>Set 7</strong></td>
<td><strong>Set 8</strong></td>
</tr>
<tr>
<td>End Repeat</td>
<td>Arpeggio</td>
<td>Down Bow</td>
<td>Staff</td>
</tr>
<tr>
<td>Turn</td>
<td>Double Sharp</td>
<td>Pedal</td>
<td>Accent</td>
</tr>
<tr>
<td>Whole Rest</td>
<td>Gong</td>
<td>Chord</td>
<td>Glissando</td>
</tr>
<tr>
<td>Alto Clef</td>
<td>Nebenstimme</td>
<td>Circle Bow</td>
<td>Common Time</td>
</tr>
<tr>
<td>16th Note</td>
<td>Harmonic</td>
<td>Triple Tongue</td>
<td>Cymbals</td>
</tr>
<tr>
<td><strong>Set 9</strong></td>
<td><strong>Set 10</strong></td>
<td><strong>Set 11</strong></td>
<td><strong>Set 12</strong></td>
</tr>
<tr>
<td>Octave</td>
<td>Maxima</td>
<td>Brace</td>
<td>Fretboard</td>
</tr>
<tr>
<td>Volta Bracket</td>
<td>Kieván Clef</td>
<td>Drum Clef</td>
<td>Cut Time</td>
</tr>
<tr>
<td>Pedal Up</td>
<td>Half Pedal</td>
<td>Multirest</td>
<td>Quarter Sharp</td>
</tr>
<tr>
<td>Haupstimmme</td>
<td>Caesura</td>
<td>Breve</td>
<td>Minima</td>
</tr>
<tr>
<td>Porrectus</td>
<td>Damp All</td>
<td>Virga</td>
<td>Semibrevis</td>
</tr>
</tbody>
</table>
Figure 1. The peer-yoked contingency board utilized during Experiment I.
Target Responses and Measures

**Dependent variable.** The first dependent variable in this study was student rate of learning under each experimental condition, as measured by learn-units-to-criterion. Rate of learning was also demonstrated through the calculation of celeration, using cumulative record of correct responses. The learn unit is an interlocking three term contingency that consists of the presentation of an antecedent by the teacher, a student response, and an appropriate consequence delivered by the teacher (Albers & Greer, 1991). “Learn-units-to-criterion” is defined herein as the number of learn units that a teacher had to deliver in order for the student to reach mastery criterion, which was set at three consecutive correct answers per stimulus. Celeration of learning was calculated by recording the cumulative record of responses given by each student under each condition and determining the slope of each line. A higher slope indicates faster rate of learning.

A second dependent variable in this study was the number of vocal verbal operants emitted by participants in each condition. The vocal verbal operants measured included “telling” behaviors such as offering the correct response to a peer, and “asking” behaviors such as requesting help from their peer. For participants with native disabilities who anecdotally had been identified as not emitting many functional vocal verbal operants with peers, an additional measure of mands, tacts, sequelics, conversational units, approvals, and disapprovals were also included. See Appendix A for a detailed description of these vocal verbal operants as defined by Skinner (1957).

**Independent variables.** The independent variables in this study were the different reinforcement operations under which learn units were delivered under in each experimental condition. The two conditions were (A) learn units delivered to a pair of participants who were
yoked together for reinforcement (collaborative contingency), and (B) learn units delivered to a pair of participants who were not yoked together for reinforcement (individual contingency). The conditions will herein be referred to as (A) collaborative and (B) individual.

**Procedure.** In both conditions, learn units were delivered in a rotated fashion (one at a time) to each participant in the dyad. Correct responses were reinforced with social praise, wherein the experimenter delivered vocal praise like, “Great job! You got it!” and occasional physical gestures such as a high five or thumbs up. Incorrect responses received a vocal correction, wherein the experimenter said the correct name for the stimulus and the participant was given an opportunity to respond independently.

During condition (A), a peer-yoked contingency (Davies-Lackey, 2005; Stolfi, 2005) was employed. The peer-yoked contingency was established through the use of a game board, which consisted of two characters competing to reach the top in order to access a predetermined backup reinforcer. Participants were given time before each session to discuss with each other and decide on a mutually desirable reinforcer that they would work towards. Participants were paired up into a “team,” and they competed against the experimenter. Learn units were delivered to each student in a rotated fashion. Each participant was taught a separate set of stimuli to mastery. If either participant emitted a correct response, their character moved up on the game board. If either participant emitted an incorrect response, the experimenter gave a correction while moving her piece up on the game board. Students only accessed the backup reinforcer if their team made it to the top of the game board before the experimenter did.

Under condition (B), participants were paired together but a yoked contingency was not included. Learn units were delivered to each participant in a rotated fashion, but their
reinforcement was not yoked with the other participant. Correct responses were reinforced with social praise from the experimenter, and a vocal correction was provided for incorrect responses. The game board was not present. This condition can be viewed as a control condition, in which the yoked contingency was removed. The only difference between the collaborative (A) condition and individual (B) condition was the presence of the yoked contingency.

**Data Collection**

Data were collected using black ink pens, clipboards, and pre-made data sheets. Data were recorded on correct and incorrect responses emitted by participants. A plus (+) was recorded for correct answers and a minus (−) was recorded for incorrect answers. Following mastery of an entire set of stimuli, learn units to criterion and celeration of learning were calculated. Additionally, data were collected on the number of times participants interacted with each other in the form of asking for help, offering help, delivering approvals, and delivering disapprovals.

**Interobserver Agreement**

An independent observer who had previously been trained in the procedure recorded data simultaneously with the experimenter, in order to ensure fidelity of implementation. The interobserver agreement for this experiment was calculated by dividing the total number of agreements by the total number of observations, and then multiplying the number by 100. Interobserver agreement was taken during 41% of teaching sessions. The mean interobserver agreement for all sessions across dyads was 98.2% with a range of 94-100% agreement.

**Experimental Design**

The design was an ABAB reversal design (Baer, Wolf, & Risley, 1968). Each condition
was implemented until the participants met mastery criterion for one set of tact stimuli. The conditions were rotated in an ABAB fashion in order to allow for a functional comparison of rate of learning under each condition. The first condition for each dyad was selected at random, and the sequence followed accordingly. The conditions were counterbalanced across dyads. See Table 4 for an outline of the experimental sequence.

**Table 4.**

*Description of reinforcement operations in each experimental phase, where (A) represents the collaborative contingency and (B) represents the individual contingency. The counterbalance across dyads is highlighted.*

<table>
<thead>
<tr>
<th>Participants</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyad 1 (1 &amp; 2)</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Dyad 2 (3 &amp; 4)</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Dyad 3 (5 &amp; 6)</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Dyad 4 (7 &amp; 8)</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Dyad 5 (9 &amp; 10)</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Dyad 6 (11 &amp; 12)</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
</tbody>
</table>
**Results**

Figure 2 and Figure 3 demonstrate the rate of learning for Dyad 1. Figure 2 shows the total and mean learn units to criterion. Participant 1 learned the fastest in the collaborative condition, with a mean number of learn units to meet criterion of 53. Participant 1 required a mean number of 59 learn units to meet criterion in the individual condition. Participant 2 also learned the fastest in the collaborative condition, with a mean learn units to criterion of 44. Participant two required a mean of 65 learn units to meet criterion in the individual condition.

Figure 3 shows the cumulative correct responses emitted by Participant 1 and 2 were graphed and celeration calculated. A higher slope, indicated by a higher x co-efficient (y=mx+b, where m=slope), demonstrates faster learning. Participant 1’s celeration of learning under the collaborative condition was 0.39 while it was 0.33 in the individual condition. Participant 2’s celeration of learning under the collaborative condition was 0.52, while it was 0.26 in the individual condition. Additionally, Participants 1 and 2 interacted with each other by either requesting or offering help a total of 61 times—36 times in the collaborative conditions and 25 times in the individual conditions. See Figure 14 for a complete breakdown of the interactions. These data together suggest that both Participants 1 and 2 had reinforcement for collaboration.

Figure 4 and Figure 5 show the rate of learning for Dyad 2. Participant 3 learned the fastest in the collaborative condition, with a mean number of 60 learn units required to meet criterion. Participant 3 required a mean of 79 in the individual condition. Participant 4 required a mean 75 in the individual condition, and a mean of 100 learn units in the collaborative condition. Figure 5 shows the cumulative correct responses emitted in each condition by Participants 3 and 4. The slopes of each line demonstrate the rate of learning, with a higher slope signifying faster
learning. Participant 3’s celeration of learning was .68 under the collaborative condition, and .41 under the individual condition. Although Participant 4 did require fewer learn units to meet criterion in the individual condition, the celeration of learning in the collaborative condition was .36 while it was .26 in the individual condition. Additionally, Participants 3 and 4 interacted with each other by either requesting or offering help for a total of 66 interactions (see Figure 14). These data, coupled with the vocal verbal operants, suggest that Participant 3 and Participant 4 demonstrated reinforcement for collaboration.

Figure 6 and Figure 7 show the rate of learning Dyad 3 in each phase. Participant 5 learned slightly faster in the individual condition, with a mean of 28 learn units to meet criterion. Participant 5 required a mean of 34 learn units to meet criterion in the collaborative condition. Participant 6 also learned slightly faster in the individual condition, with a mean of 38 learn units to criterion in the individual condition and 41 learn units to criterion in the collaborative condition. Celeration of learning for Participant 5 was 0.497 in the individual condition and 0.398 in the collaborative condition. Celeration of learning for Participant 6 was 0.497 in the individual condition and 0.392 in the collaborative condition (See Figure 7). Participants 5 and 6 did not request for or offer help to their partner in either condition. The number of vocal verbal operants emitted by Participant 5 and 6, including asking for help, offering help, delivering approvals and disapprovals, are shown in Figure 14. These data suggest that Participants 5 and 6 did not have reinforcement for collaboration.

Figure 8 and Figure 9 show the rate of learning for Dyad 4 in each phase. Participant 7 learned faster in the collaborative condition, with a mean of 34 learn units to meet criterion. Participant 7 required a mean of 44 learn units to meet criterion in the individual condition.
Participant 8 also learned faster in the collaborative condition, with a mean of 37 learn units to criterion in the individual condition and 43 learn units to criterion in the collaborative condition. Figure 9 provides an additional measure of their rate of learning across conditions. The celeration of learning for Participant 7 was 0.463 in the collaborative condition and 0.460 in the individual condition. The celeration of learning for Participant 8 was 0.46 in the collaborative condition and 0.38 in the individual condition. The number of vocal verbal operants emitted by Participant 7 and 8, including asking for help, offering help, delivering approvals, and disapprovals, are shown in Figure 14. Participants 7 and 8 asked or offered help a total of 63 times across phases, and emitted a total of 16 approvals to each other. These data suggest that Participants 7 and 8 did have reinforcement for collaboration.

Figure 10 and Figure 11 show the rate of learning for Dyad 5 in each phase. Participant 9 learned faster in the individual condition, with a mean of 32 learn units to meet criterion. Participant 9 required a mean of 43 learn units to meet criterion in the collaborative condition. Participant 10 also learned faster in the individual condition, with a mean of 50 learn units to criterion in the individual condition and 36 learn units to criterion in the collaborative condition. The celeration of learning for Participant 9 was 0.41 in the individual condition and 0.39 in the collaborative condition. The celeration of learning for Participant 10 was 0.36 in the individual condition and 0.28 in the collaborative condition (See Figure 11). Participants 9 offered help to his partner two times, and Participant 10 did not request for or offer help to their partner in either condition. The number of vocal verbal operants emitted by Participant 9 and 10, including asking for help, offering help, delivering approvals, and disapprovals, are shown in Figure 14. These data suggest that Participants 9 and 10 did not have reinforcement for collaboration.
Figure 12 and 13 show the rate of learning for Dyad 6 in each phase. Participant 11 learned faster in the collaborative condition, with a mean of 26 learn units to meet criterion. Participant 11 required a mean of 43 learn units to meet criterion in the individual condition, suggesting he had reinforcement for collaboration. Participant 12 learned faster in the individual condition, with a mean of 59 learn units to criterion in the individual condition and 83 learn units to criterion in the collaborative condition. The celeration of learning for Participant 11 was 0.62 in the collaborative condition and 0.47 in the individual condition. The celeration of learning for Participant 12 was 0.25 in the collaborative condition, and 0.30 in the individual condition. The number of vocal verbal operants emitted by Participant 11 and 12, including asking for help, offering help, delivering approvals, and disapprovals, are shown in Figure 14. Participants 11 offered help to his partner 32 times across conditions and asked for help 0 times. Participant 12 offered to help 1 time and asked for help 1 time. These data suggest that Participant 12 did not have reinforcement for collaboration, while Participant 11 did.
Figure 2. Total and mean number of learn units required to meet mastery criterion for a set of tact stimuli in each of four experimental phases for Dyad 1. Lower number of learn units indicates faster learning.
Figure 3. Record of cumulative correct responses to mastery emitted by Dyad 1 under Collaborative and Individual reinforcement conditions.
Figure 4. Total and mean number of learn units required to meet mastery criteria across conditions for Dyad 2. Lower number of learn units indicates faster learning.
Figure 5. Record of cumulative correct responses to mastery emitted by Dyad 2 across experimental phases and reinforcement conditions.
Figure 6. Total and mean number of learn units required to meet mastery criteria across conditions for Dyad 3. Lower number of learn units indicates faster learning.
Figure 7. Record of cumulative correct responses to mastery emitted by Dyad 3 across experimental phases and reinforcement conditions.
Figure 8. Total and mean number of learn units required to meet mastery criteria across conditions for Dyad 4. Lower number of learn units indicates faster learning.
Figure 9. Record of cumulative correct responses to mastery emitted by Dyad 4 across experimental phases and reinforcement conditions.
Figure 10. Total and mean number of learn units required to meet mastery criteria across conditions for Dyad 5. Lower number of learn units indicates faster learning.
Figure 11. Record of cumulative correct responses to mastery emitted by Dyad 5 across experimental phases and reinforcement conditions.
Figure 12. Total and mean number of learn units required to meet mastery criteria across conditions for Dyad 6. Lower number of learn units indicates faster learning.
Figure 13. Record of cumulative correct responses to mastery emitted by Dyad 5 across experimental phases and reinforcement conditions.
Figure 24. Number of telling, asking, approval and disapproval vocal verbal operants emitted by each Dyad under collaborative and individual reinforcement conditions.
DISCUSSION

General Discussion

The first research question I sought to answer in this study was: Is reinforcement for collaboration a developmental cusp? A verbal behavior developmental cusp (Greer & Ross, 2008; Rosales, Ruiz & Baer, 1996) has been identified in the literature as something that allows an individual to contact new contingencies in their environment, and as such may allow them to learn differently or more quickly. The results for each participant demonstrate how the yoked contingency can impact rate of learning for different children. The data show that seven participants (Participants 1, 2, 3, 4, 7, 8, and 11) had reinforcement for collaboration, in that they learn at a faster rate when yoked with a peer than they do by themselves or simply paired with a peer. Five participants (Participants 5, 6, 9, 10, and 12) do not demonstrate reinforcement for collaboration. Greer & Du (2015) describe how reinforcers, especially social reinforcers, affect the development of complex social behaviors. Based on the data from Experiment 1, reinforcement for collaboration may be an important developmental cusp that can help increase rates of learning for elementary-aged students.

There are two general notes in regards to the data from Experiment 1. First, although Participant 4 required more learn units in the collaborative condition than in the individual condition, his celeration of learning increased under the collaborative condition and he emitted numerous vocal verbal operants with his peers, which suggests that he did in fact demonstrate reinforcement for collaboration. Another important note is that all of the participants who demonstrated reinforcement for collaboration were anecdotally observed to request to play the peer-yoked contingency game outside of the experimental conditions. While these findings are
specific to the individual participants, the five participants who did not demonstrate reinforcement for collaboration were also students who had an educational classification and IEP. Through the method of agreement, it might be suggested that reinforcement for collaboration is a deficit that should be investigated with particular regard for students with Autism or other related disorders.

The yoked contingency game board has proven to be effective in inducing various other verbal behavior developmental cusps including Observational Learning and Social Listener Reinforcement (Baker, 2014; Sterkin, 2012; Greer & Ross, 2008; Rothstein & Gautreaux, 2007; Stolfi, 2005; Davies-Lackey, 2005). It has also been shown to be an effective motivational tactic in CABAS® AIL classrooms (Greer, 2002). The results from Experiment I support these previous findings on the yoked contingency game board, and further illustrate how it can be utilized as an instructional tactic to increase rate of learning.

Students who do not demonstrate reinforcement for collaboration are at a disadvantage in a general education setting, where they are required to do most, if not all, learning in a group setting. When reinforcement for collaboration with peers is present, group instruction and contingencies are more effective pedagogical methods. Students who do not have reinforcement for collaboration may not be able to access group contingencies, and as such may not meet their learning potential in a general education setting.

**Limitations and future implications.** A major limitation of this study was participant selection and a small sample size. Although experimental conditions were assigned to dyads randomly, participants were paired together in dyads by classroom based on convenience. A random assignment partners would have allowed for more control of confounding variables
including familiarity or prior instructional history with peers. A larger sample size with random pair assignment would provide further information on the differences in rate of learning between students who have reinforcement for collaboration and those who do not.

Some of the participants demonstrated an increased rate of learning as the experimental phases continued, which could be related to a possible spillover effect. Additional phases could have been implemented until steady state responding was observed, or perhaps another learning task could have been measured to better demonstrate the differences in learning. Another limitation in this experiment was that the difference in rates of learning across conditions was small for some participants. This could also be attributed to either a spillover effect or the specific stimuli that were used in the learning tasks.

Future research could seek to explore the effects of a collaborative contingency on rates of learning in a larger population sample, and across different academic tasks. A measure of performance behavior could also strengthen the determination of the effects of the contingency.

**Rationale for Experiment II**

In preparing students for success in a general education classroom it is necessary to consider their level of verbal behavior development in an academic and social context. Both children with special needs and children who are neuro-typically developing would benefit from having reinforcement for collaboration, so that they can contact group contingencies in the classroom and learn at faster rates. As a teacher of a self-contained classroom who is trying to transition students successfully into full time inclusion in a general education setting, it is crucial for me to be able to identify the necessary skills and milestones that will enable my students to succeed.
Reinforcement for collaboration is especially important for children who have a native disability like an Autism Spectrum Disorder, which impacts their communication and social skills. Experiment 1 addressed a basic science question: is reinforcement for collaboration a developmental cusp? An applied question will be addressed in Experiment 2. In this experiment, the participants from Experiment 1 who did not demonstrate reinforcement for collaboration participated in a collaborative intervention in order to test if it would induce this developmental cusp.
EXPERIMENT II: ESTABLISHING REINFORCEMENT FOR COLLABORATION

Method

Participants

Four participants were selected from either a self-contained or inclusion (AIL) CABAS® model classrooms in a public elementary school. Participants were selected because they did not demonstrate reinforcement for collaboration, as demonstrated in Experiment I (Participants 5, 6, 9, 10, 12). The four participants were educationally classified as having a developmental disability, including Autism Spectrum Disorder and microcephaly. A fifth potential participant was classified as an English Language Learner (ELL), but dropped out of the study before completion. Peer confederates were selected from Experiment I participants who did demonstrate reinforcement for collaboration. Refer to Table 1 for demographic details on target participants and confederates. Table 4 provides additional details on the target participants in Experiment II.

Setting and Materials

The experiment was conducted at a table in the classroom. Students were seated across from each other, in clear view of the yoked contingency game board. The experimenter sat next to the yoked contingency game board. Materials included all materials listed in Experiment 1, as well as index cards, post it notes, and a yoked contingency game board.
Target Responses and Measures

**Dependent Variables.** The primary dependent variable was reinforcement for collaboration, as measured through rate of learning with and without a yoked contingency. The secondary dependent variable was the number of vocal verbal operants emitted by participants when paired with a peer before and after intervention.

**Independent Variable.** The independent variable was a collaborative intervention that

<table>
<thead>
<tr>
<th>Participant</th>
<th>Level of Verbal Behavior</th>
<th>Educational Classification</th>
<th>Age/Grade/Sex*</th>
<th>Relevant Cusps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 5</td>
<td>Listener/Speaker, Reader/Emergent Writer</td>
<td>Autism</td>
<td>6.9/1st/M</td>
<td>Full Naming, OL for learning &amp; performance, TSF</td>
</tr>
<tr>
<td>Participant 6</td>
<td>Listener/Speaker, Emergent Reader/Writer</td>
<td>Autism</td>
<td>6.0/K/F</td>
<td>Full Naming, OL for learning &amp; performance, TSF</td>
</tr>
<tr>
<td>Participant 9</td>
<td>Listener/Speaker, Emergent Reader/Writer</td>
<td>Autism</td>
<td>6.0/K</td>
<td>Full Naming, OL for learning &amp; performance, TSF, SLR</td>
</tr>
<tr>
<td>Participant 10</td>
<td>Listener/Speaker, Emergent Reader/Writer</td>
<td>Other Health Impaired</td>
<td>5.5/K/F</td>
<td>Listener component of Naming, OL for performance, SLR</td>
</tr>
</tbody>
</table>

*Note: Participant age is recorded in years. Grade levels include Kindergarten (K) and 1st grade (1st), and sex refers to male (M) or female (F).
engaged target participants in peer tutoring with a confederate, and included a yoked contingency game board.

**Procedure**

**Pre-intervention probes.** Prior to intervention, participant rate of learning was measured as learn units to criterion under two conditions: (A) collaborative contingency and (B) individual contingency (see Experiment 1 procedure). The number of vocal verbal operants emitted by all participants was also recorded during these pre-intervention probes. Vocal verbal operants that were measured included approvals, disapprovals, telling a peer the answer, asking for help from a peer, sequels, conversational units, and tacts.

**Intervention.** All target participants and peer confederates had been exposed to learn unit and peer tutoring procedures unrelated to the study in their classrooms before the onset of the intervention. During the intervention, target participants were paired with a peer confederate. Both the target and confederate were given the opportunity to serve as tutor and tutee. Reinforcement for both the target and the participant was yoked via a peer-yoked contingency game board. They were required to collaborate in order to move their piece to the top of the game board and access their selected backup reinforcer.

In the peer tutoring procedure, the tutor was required to deliver a learn unit to the tutee. If the tutor delivered an in tact learn unit (i.e. presented antecedent correctly, allowed for tutee to respond, provided appropriate consequence) and the tutee responded correctly, the students received reinforcement in the form of moving up on the yoked contingency game board. If the tutor did not deliver an in tact learn unit or the tutee did not respond correctly, the experimenter moved up on the game board. That is, both the participant and the confederate were required to
emit the correct behavior in order for their team to move up on the game board. This differed from pre and post-experimental probes in that the act of collaboration (peer tutoring) was being reinforced through the yoked contingency.

The confederate was selected as the tutor first. They presented the target participant with 20 learn units per session. The tutor was given 10 index cards, each with a grade level addition or subtraction math fact written on the front (e.g. 2+2=) and the correct answer written on the back (e.g. 2+2=4). The tutor presented the index card to the tutee, and the tutee was given the opportunity to respond. If the tutee emitted a correct response, the tutor was expected to deliver reinforcement in the form of vocal praise. If the tutee emitted an incorrect response, the tutor was expected to deliver a vocal correction. The experimenter moved the students’ game piece up on the board when they both emitted a correct response, or the experimenter’s piece if either student did not emit a correct response. If the tutor did not present a complete learn unit, the experimenter gave them a correction by modeling the entire learn unit sequence.

Criteria for the target participants in the intervention was set as 90% or better accuracy during one session as the tutee, and one session as the tutor. That is, the target participants were required to learn the math facts presented to them by the confederate to at least 90% mastery, and then they were required to deliver learn units to the confederate such that the confederate learned their math facts to at least 90% accuracy.

**Interobserver Agreement (IOA)**

An independent observer who had previously been trained in the procedure recorded data simultaneously with the experimenter, in order to ensure fidelity of implementation. The interobserver agreement for this experiment was calculated by dividing the total number of
agreements by the total number of observations, and then multiplying the number by 100. Interobserver agreement was taken during 30% of intervention sessions. The mean interobserver agreement for all sessions across peer tutoring dyads was 100%. IOA was conducted for 50% of post-probe sessions, with a mean agreement of 100%.

**Design**

The design for this experiment included a delayed multiple probe (Horner & Baer, 1978) across dyads implementation, with a pre- and post- intervention AB reversal design. In the pre- and post-intervention alternating treatments phases, the dependent variables were measured and paired across the collaborative and individual conditions. Intervention was implemented for Dyad 1, and following completion of the intervention by Dyad 1, Dyad 2 entered into intervention.

**Results**

Figure 15 demonstrates the mean number of learn units participants required to meet criteria for mastering a novel set of music stimuli across the yoked and individual conditions. Following intervention, Participants 5 and 6 demonstrated slightly faster learning during the yoked contingency condition than during the individual condition. These results suggest that they acquired reinforcement for collaboration after engaging in the collaborative peer tutoring activity. Prior to intervention, Participant 5 required a mean of 32 learn units to acquire music note stimuli under the collaborative condition, and 28 under the individual condition. After intervention, Participant 5 required a mean of 23 learn units under the collaborative condition and a mean of 30 under the individual condition. Prior to intervention, Participant 6 required a mean of 41 learn units under the collaborative condition and a mean of 38 under the individual condition.
condition. After intervention, Participant 6 required a mean of 23 learn units under the collaborative condition and a mean of 31 under the individual condition.

Dyad 2 also demonstrated faster learning during the yoked contingency condition than during the individual condition following intervention. Prior to intervention, Participant 9 required a mean of 43 learn units to acquire a set of novel music stimuli under the collaborative condition and a mean of 32 learn units under the individual condition. After intervention, Participant 9 required a mean of 40 learn units to meet criterion under the collaborative condition and a mean of 61 learn units under the individual condition. Prior to intervention, Participant 10 required a mean of 50 learn units to meet criteria under the collaborative condition, and a mean of 36 learn units to meet criteria under the individual condition. After intervention, Participant 10 required a mean of 50 learn units to meet criteria under the collaborative condition, and a mean of 36 learn units to meet criteria under the individual condition.

Figure 16 demonstrates Participants’ 5 and 6 celeration of learning across each condition, before and after intervention, as determined by cumulative responses. After the cumulative responses were recorded, the celeration of learning was calculated by identifying the slope (y=mx + b) of the line. A higher (x) coefficient indicates a steeper slope, and faster learning. Prior to intervention, Participant 5’s celeration of learning was 0.67 in the individual condition and 0.55 in the collaborative condition. After intervention, it was 0.65 in the individual condition and 0.69 in the collaborative condition. Prior to intervention, Participant 6’s celeration of learning was 0.497 in the individual condition and 0.398 in the collaborative condition. After intervention it was 0.58 in the individual condition and 0.675 in the collaborative condition.

Figure 17 demonstrates Participants’ 9 and 10 mean rate of learning across each
condition, before and after intervention, as determined by cumulative responses. After the cumulative responses were recorded, the celeration of learning was calculated by identifying the slope (y=mx + b) of the line. Prior to intervention, Participant 9’s celeration of learning was 0.40 in the individual condition and 0.39 in the collaborative condition. After intervention, it was 0.25 in the individual condition and 0.41 in the collaborative condition. Prior to intervention, Participant 10’s celeration of learning was 0.366 in the individual condition and 0.28 in the collaborative condition. Following intervention, it was 0.29 in the individual condition and 0.40 in the collaborative condition.

Figure 18 displays the number of vocal verbal operants emitted by Participants 5 and 6 during pre and post intervention probes under yoked and individual conditions. Figure 19 displays the number of vocal verbal operants emitted by Participants 9 and 10 during pre and post intervention probes under yoked and individual conditions.
Figure 15. The mean learn units to criterion that Dyads 1 and 2 required to master novel stimuli, before and after intervention.
Figure 16. The cumulative correct responses to mastery emitted by Participant 5 and 6 across each condition, before and after intervention.
Figure 17. The cumulative correct responses to mastery emitted by Participant 9 and 10 across each condition, before and after intervention.
Figure 18. The number of vocal verbal operants emitted by participants during probe sessions before and after intervention under the yoked and paired learning conditions.
Discussion

General

The results show a shift in rate of learning for all four participants, who learned faster under the individual condition prior to intervention, and then learned faster under the collaborative condition after intervention. Additionally, all four participants emitted considerably higher numbers of vocal verbal operants during post intervention probes. These results suggest that the collaborative peer tutoring intervention may have induced the developmental cusp of reinforcement for collaboration in these participants.

Limitations and future research.

The study is not without limitations. The difference in rate of learning as measured in learn units to criterion and celeration was small. This is likely attributed to a basement effect. That is, the participants learned the music symbol stimuli very quickly, and required a low number of learn units to meet criterion. This makes it difficult to see a strong effect of the intervention.

Another limitation to this Experiment is that the probe stimuli were not counterbalanced for pre and post intervention probes. As Experiment 2 was only developed after Experiment 1 was complete, I did not allow for this counterbalance to be included in the design. The stimuli were only counterbalanced across experimental conditions, but not across pre and post probes. Furthermore, the study was limited in the small number of participants and convenience sampling.

Future research should include different learning and performance tasks to measure the difference in rates of learning across the reinforcement conditions.
Vocal Verbal Operants

Based on the vocal verbal operant data, it could be argued that there was a shift in reinforcement from what Greer & Du (2015) described as “social contract” behavior to “social contact” behavior. That is, prior to intervention, very limited numbers of vocal verbal operants were emitted between the participants. Greer & Du (2015) theorized these distinctive classes of behavior based on the source of their social and verbal reinforcement.

In this experiment, the only operants that were emitted pre-intervention were either disapprovals or echoic approvals (approvals that were not emitted independently or functionally, just echoing the teacher). Post-intervention participants emitted higher rates of vocal verbal operants, including tacts, sequelics, and conversational units. They were anecdotally observed laughing with each other, making more eye contact with each other, and engaging more with their peers than the experimenter during the post-intervention phases. Examples of vocal verbal operants emitted following intervention included: “We did it!” “You know this one,” “I hope we get to the top,” “We’re going faster than Ms. Darcy,” “I want you to get the prize,” and “You’ll get the next one.” These vocal verbal operants demonstrate a level of reinforcement simply through social contact and collaboration with a peer, as opposed to pre-intervention vocal verbal operants that did not function as social contact.
Chapter IV

GENERAL DISCUSSION

Overview

In two experiments, I investigated reinforcement for collaboration, in order to determine if it could be identified as a developmental cusp that allows students to contact new (collaborative) contingencies in their environment (Rosales-Ruiz & Baer, 1996). Additionally, I tested the effects of a collaborative intervention on the establishment of reinforcement for collaboration in students who did not demonstrate it previously.

In Experiment I, I measured the rate of learning of 12 participants under two reinforcement conditions: (A) a collaborative contingency and (B) an individual contingency. In both conditions, participants were taught novel music symbol stimuli in the presence of a peer, and their rate of learning was measured through calculating learn-units-to-criterion. The collaborative condition involved a peer-yoked contingency that was established through the use of a game board; the participants’ access to reinforcement was “yoked” together and as such they needed to collaborate in order to acquire reinforcement. The individual condition controlled for this collaborative contingency by removing the game board; that is, reinforcement was delivered to the participants individually. Results showed that seven of the 12 participants learned faster and emitted a higher number of vocal verbal operants under the collaborative contingency, suggesting that they did indeed have reinforcement for collaboration.

In Experiment II, the five participants who did not demonstrate this reinforcement for collaboration were selected to participate. Participants were paired with a peer confederate, and engaged in peer tutoring both as the “tutor” and the “tutee.” During intervention, a peer-yoked
contingency game board was present. Participants were required to collaborate with the peer confederate in order to move up on the game board and access reinforcement. Following intervention, rate of learning for novel music stimuli was again measured under the two reinforcement conditions (collaborative and individual). Results showed a shift in rate of learning and the emission of vocal verbal operants, suggesting that the collaborative intervention may have been effective in inducing reinforcement for collaboration in these participants. In the following sections, I will discuss the major findings of these two experiments together, as well as the educational significance and implications for future research presented by this study.

Major Findings

Is Reinforcement for Collaboration a Developmental Cusp?

In the Verbal Behavior Development Theory (Greer & Keohane, 2005; Greer & Ross, 2008; Greer & Speckman, 2009), a developmental trajectory is outlined in the context of developmental cusps and capabilities. Developmental cusps (Rosales-Ruiz & Baer, 2009) allow an individual to contact new contingencies in their environment, and cusps that are also capabilities allow and individual to learn in new ways. A wide body of basic and applied research has identified the reinforcers that result in these cusps and capabilities, as well as interventions that can be implemented in order to induce them when they are found to be missing (Greer & Du, 2015).

Based on the previous literature and the definition of a verbal behavior developmental cusp, the current study provides evidence to support the idea that reinforcement for collaboration is a developmental cusp, one that is perhaps a necessary prerequisite for other cusps and capabilities to emerge (Gold, 2013; Byers, 2016). The functional analyses conducted in
Experiment I demonstrated a difference in the rate of learning for all 12 participants when they were taught novel tact stimuli under a collaborative reinforcement condition as compared to an individual reinforcement condition. This difference suggests that participants who have reinforcement for collaboration learn faster, and thus more effectively, under a collaborative reinforcement contingency. As such, a child who does not demonstrate reinforcement for collaboration cannot contact collaborative contingencies in their environment, for example in a general education classroom.

Additionally, the data from Experiment I show that those participants who did demonstrate reinforcement for collaboration also emitted higher numbers of vocal verbal operants with their peers than the participants who did not demonstrate reinforcement for collaboration. This further supports the view of reinforcement for collaboration as a developmental cusp that may directly impact social reinforcement in general.

**Social contact vs. social contract behavior.** Verbal behavior is social behavior (Skinner, 1957). From a radical behaviorist standpoint, behavior, including language, is selected out by its consequences. Collaboration then, if it is to be of any utility to an individual, must eventually acquire reinforcing properties of its own. At some point, the function of collaborative behavior must shift from social *contract* to social *contact* (Greer & Du, 2015). In order for an individual to engage in collaborative activities, specifically in collaborative learning, reinforcement for collaboration must be in place. In the context of learning in a general education elementary school classroom, collaboration with others is a critical component of social development.

For the purpose of this study, “reinforcement for collaboration” was identified based on
student rate of learning and social interactions under different reinforcement conditions. I sought to investigate the underlying mechanism of collaborative behavior in the context of elementary school classrooms. A broad criteria was established in order to determine if participants could be said to demonstrate reinforcement for collaboration: faster learning under collaborative reinforcement conditions than under individual reinforcement conditions, and the emission of vocal verbal operants that functioned to be social.

Those participants who learned faster under the collaborative reinforcement condition, and also emitted social vocal verbal operants with their peers demonstrated the cusp of reinforcement for collaboration. Their behavior was emitted under a different, social, stimulus control that other participants’ behavior was not. That is, their behavior was social contact behavior (Greer & Du, 2015). They collaborated with their peer not just to access a backup reinforcer, but to access social reinforcement through and with their peers. Participants who did not demonstrate reinforcement for collaboration did not engage in social contact behavior. The difference in reinforcers between social contact behavior and social contract behavior is crucial to understanding the underlying social reinforcers that facilitate learning and collaboration in the classroom.

**Can Reinforcement for Collaboration be Established?**

While the data from Experiment I support the hypothesis that reinforcement for collaboration is in fact a developmental cusp, the data from Experiment II point to the possibility of establishing this cusp in students who do not demonstrate it. Results of Experiment II demonstrate a functional relationship between a collaborative peer-tutoring intervention and the establishment of reinforcement for collaboration in participants who did not previously
demonstrate it.

According to Greer & Du (2015), “Cusps appear to emerge as a result of the onset of new learned reinforcers” (p. 19). As such, it could be argued that a collaborative intervention results in the acquisition of a newly learned reinforcer—collaboration with a peer. This conditioned reinforcement is vital to understand the source of collaboration and how it can contribute to student success in the classroom.

**Rate of Learning.** All 12 participants in Experiment I demonstrated a difference in their rate of learning across reinforcement conditions. Conclusions can be drawn from these data as to whether or not the participant demonstrated reinforcement for collaboration. Four participants who did not learn faster under the collaborative contingency were then selected for intervention in Experiment 2.

Following this collaborative intervention, the rate of learning under the collaborative contingency increased for all four participants. Although the difference between the rates of learning under collaborative and individual conditions in post-intervention probes was small, a shift was demonstrated by each of the participants from their rate of learning prior to the intervention. That is, before the collaborative intervention, all of the participants learned more quickly under the individual reinforcement condition than under the collaborative reinforcement condition. After the intervention, all of the participants learned as fast or faster in the collaborative condition than in the individual condition.

**Celeration of learning.** Each participant’s rate of learning under the different reinforcement conditions was measured in two ways: the number of learn units required to meet criterion, and the celeration of learning. While the learn units to criterion measure provides a
picture of the participants’ overall rate of learning, the celeration graphs display the differences in each condition in a more detailed way. The celeration of learning as measured in this study utilized a cumulative record of responses (Skinner, 1938) to demonstrate the frequency of correct responses, as well as the rate at which they were emitted over time (Calkin, 2005; Lindsley, 1971). These measures show the nuanced differences of participant behavior (i.e. correct responses) under each reinforcement condition. While the difference in the number of learn units to criterion for some participants was very small, a distinction in the celeration of learning across conditions was still demonstrated.

**Vocal Verbal Operants.** In addition to differences in rate of learning, the participants in Experiment I who did not demonstrate reinforcement for collaboration emitted very low levels of vocal verbal operants when paired with a peer (in some cases none at all). This was distinctly different from the participants who did demonstrate reinforcement for collaboration; these participants emitted vocal verbal operants including asking for or offering help to their partners consistently in both the collaborative and individual reinforcement conditions.

After the collaborative intervention was implemented, these participants emitted increased levels of vocal verbal operants with their partners, which further suggests a shift in social reinforcement. In addition to an increased number of vocal verbal operants emitted, the “quality” of vocal verbal operants emitted was also very different following intervention. Prior to intervention these participants only emitted a few vocal verbal operants, including disapprovals and self-talk. Following intervention, they not only were asking for or offering help to their partners, they emitted higher levels of tacts, sequelics, and conversational units. Across all four participants, the greatest increase can be seen in the number of tacts emitted. As the
function of tacts is to accrue social attention, this is a notable development.

**Collaborative Intervention.** Peer tutoring has been shown to be an effective tactic to use in classrooms that benefits both the student who delivers instruction and the student who receives it (Delgado & Greer, 2009; Greer et al, 2004; Lawson & Trapenberg, 2007). It is inherently collaborative in nature, as both parties are required to work together. However, an individual who does not have reinforcement for collaboration may not be able to engage in peer tutoring effectively, or may do so only as social contract behavior to access a backup reinforcer.

In Experiment II, I coupled the collaborative activity of peer tutoring with a yoked contingency, and saw a shift in reinforcement for participants after they engaged in the intervention. It appears that the yoked contingency functioned to condition the act of collaboration (in the case of the intervention, peer tutoring). The shift from social contract behavior to social contact behavior following the intervention is demonstrated in the post-experimental probes, wherein participants engaged in faster learning and emitted higher rates of social interactions under a collaborative reinforcement contingency, suggesting that reinforcement for collaboration was established. Further research is needed to determine the exact mechanism at work in this intervention, and the development of reinforcement for collaboration.

**Limitations and Future Research**

The present study provides only a small scope of a much broader topic that remains to be explored. By controlling for the collaborative contingency, I demonstrated that reinforcement for collaboration may be considered a developmental cusp that can be induced in students who do not demonstrate it.

Both experiments were limited in their participant sample size and selection. This small
group of participants was selected and paired through convenience sampling; a larger sample that is randomly assigned to experimental dyads would provide a clearer picture of how reinforcement for collaboration can effect student rate of learning and social performance. Additionally, a larger sample of participants might lead to further assessment of group differences. For example, more data from a larger sample could provide valuable information on the differences in reinforcement for collaboration in typically developing students as compared to students with a developmental disability like an Autism Spectrum Disorder.

Further research should not only include a wider population sample, but could also include different learning and performance tasks in a functional analysis, in order to demonstrate the differences in rate of learning across reinforcement conditions more clearly. Because some participants learned the novel music symbol stimuli relatively quickly, the differences in their rate of learning across conditions were slight. A further assessment of how collaborative contingencies might impact rate of learning across different content areas as well as school performance behaviors could provide valuable information for both teaching and classroom management practices. This would also serve to demonstrate how the results might be generalized to other samples of participants who share similar characteristics to those participants from this study.

Additionally, if reinforcement for collaboration is to be considered a developmental cusp, it will be necessary to identify and test a more specific criteria for how it can be identified in students. Future research might include repeated measures of learning over different academic and performance tasks, and for longer periods of time. With additional data collection, a specific empirical criterion for the demonstration of reinforcement for collaboration could be established.
Educational Significance and Implications

The present findings support recent research in the areas observational learning and the importance of peer presence. Recent dissertation research by Baowaidan (2016), Byers (2016), Gold (2013), and Vassare (2017) investigate the effects of peer presence and observation on the acquisition of observational learning. They each demonstrate the necessity of peer presence for observational interventions to be functional. Similarly, studies on social listener reinforcement (Baker, 2014; Sterkin, 2012) indicate the effectiveness of a peer-yoked contingency in conditioning appropriate social interactions.

In conjunction with these findings, the results of my study demonstrate the source of reinforcement—reinforcement for collaboration—in the yoked contingency, and how it can effect student learning and social interactions. Reinforcement for collaboration is something that arguably has contributed to the survival of Homo sapiens and cultural evolution in general (Greer & Du, 2015; Skinner, 1984; Tomasello, 2008; Tomasello, 2014). It may contribute to that distinctly human quality which separates humans from other animals who engage in cooperative behavior but do not “collaborate” for a common goal (Tomasello, 2014).

It is the responsibility of the teacher as a strategic scientist to identify factors that will contribute to effective teaching and overall student success (Greer, 1991). Reinforcement for collaboration can be viewed as an important factor that may allow students to learn faster and contact new contingencies in their environment.

Conclusion

The data from the present study suggest that reinforcement for collaboration may be a developmental cusp. Participants with reinforcement for collaboration were shown to learn
faster under a collaborative contingency condition and emit higher numbers of vocal verbal
operants with their peers than participants who did not demonstrate reinforcement for
collaboration. A collaborative peer tutoring intervention was effective in establishing a shift in
reinforcement from social *contract* to social *contact* for participants who did not previously
demonstrate reinforcement for collaboration. These findings present information that can both
contribute to future research as well as to inform best teaching practices.
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