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Evaluation of a Computer-Based Observer-Effect Training on Mothers' Vocal Imitation of Their Infant

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EVALUATION OF A COMPUTER-BASED OBSERVER-EFFECT TRAINING

ON MOTHERS' VOCAL IMITATION OF THEIR INFANT

by

Kerry A. Shea

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ABSTRACT

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by

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Infants begin to learn important skills, such as contingency learning, social referencing, and joint attention through everyday interactions with their environment. When infants learn that their behavior produces a change in their environment, concomitant changes in infant behavior manifest, including increased smiling and sustained engagement. Contingent maternal responses to infant behavior support infant contingency learning through experiences of cause and effect. The current investigation evaluated the effects of a computer-based training that aimed at teaching mothers to imitate their infant's interactions. The training included *observer-effect methodology*, meaning the mothers who participated in the current study engaged in observation and evaluation of other mothers who engaged in vocal imitation but did not themselves receive any direct coaching or feedback. All mothers completed the training during one session that lasted less than 45 min. Results indicate that all mothers increased their use

of vocal imitation post-training and maintained their performance at a two-week follow-up. Results are discussed in terms of how computer training may facilitate dissemination of responsive caregiver training.

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PUBLIC ABSTRACT

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Infants begin to learn important skills, such as contingency learning, social referencing, and joint attention through everyday interactions with their environment. When infants learn that their behavior produces a change in the environment (e.g., attention from others), infants engage in behavior that produces that effect (e.g., increases in smiling sustained engagement. When mothers and other caregivers respond immediately to infant behavior, they help their infant learn that the infant's own behavior is effective, producing a change in the environment. The current investigation evaluated the effect of a computer-based training that aimed at teaching mothers to play a vocal-imitation contingency-learning game. The training included *observer-effect methodology*, meaning the mothers engaged in observation and evaluation of other mothers engaging in vocal imitation but did not themselves receive any direct coaching or feedback. All mothers completed the training during one session and in less than 45 min. Results indicate that all mothers increased their use of vocal imitation post training and maintained their performance at a two-week follow-up. Results are discussed in terms of how computer training may facilitate dissemination of responsive caregiver training.

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INTRODUCTION

Infant Learning

Behavioral and developmental theories of infant learning suggest that infant learning occurs in part through an infant's interactions with their environment, including interactions with their caregivers (Bronfenbrenner & Morris, 2007; Mahoney, Kim, & Lin, 2007; Patterson, 2016; Sameroff, 2010; Skinner, 1963). *Infant learning*, defined by systematic changes in infant behavior in a given context begins immediately through everyday interactions with the infant's environment (Moon & Fifer, 1990; Tamis-LeMonda, Bornstein, & Baumwell, 2001). Through repeated daily interactions, infants begin to associate patterns of events and modify their behavior in response to the associations. The frequency of interactions that include both an infant response and a contingent caregiver response are associated with better developmental outcomes (Mahoney et al., 2007).

A contingency refers to the temporal relationship between two or more events that are functionally related, meaning that a change in one event is systematically related to a change in the other (Bornstein, Tamis-LeMonda, Hahn, & Haynes, 2008; Lohaus et al., 2005; Tarabulsy, Tessier, & Kappas, 1996). A *contingent caregiver behavior (CCB)* is defined as a caregiver response that follows an infant response in close temporal proximity (1 s to 5 s) and is functionally related to the future occurrence of the infant behavior (Bornstein et al., 2008; Ferjan Ramírez, Lytle, Fish, & Kuhl, 2019; Garcia, Bagner, Pruden, & Nichols-Lopez, 2015; Gilkerson et al., 2017; Lohaus et al., 2005; Roberts & Kaiser, 2011). Caregivers who respond contingently by following their

infant's already established attention (rather than following redirecting their infant's attention) better support their infant's development than responses that redirect their infant's attentional focus (Mason, Kirkpatrick, Schwade, & Goldstein, 2018; Tomasello & Farrar, 1986). Caregivers support their infant's development by helping their infant learn that the infant's own behavior produces a predictable change in the environment (i.e., contingency learning).

Infant Contingency Learning

Infant contingency learning is a process wherein, as an infant interacts with their environment, they learn that their own behavior is associated with a change in the environment. The systematic change in dimensions of the infant's behavior following repeated behavior-consequence interactions is evidence of contingency learning (Rovee-Collier & Capatides, 1979; J. S. Watson, Hayes, & Vietze, 1982). Researchers use contingency-learning arrangements to study changes in patterns of infant behavior before, during and after a period where a specific infant behavior is reinforced. The contingency-learning arrangements are similar in form to naturalistic caregiver-infant interactions where a caregiver consistently responds to their infant with a specific behavior (e.g., peek-a-boo; three little piggies). A contingency-learning game is one in which a pre-determined response is delivered contingent on the infant's behavior (Dunst, Raab, Hawks, Wilson, & Parkey, 2007; Tarabulsy et al., 1996)

A contingency-learning game measures infant behavior during an initial baseline phase, an acquisition phase, and a return to baseline phase. During the acquisition phase, one pre-determined target response (e.g., vocalizations) produces a systematic change in the environment (contingent consequence). During initial and return to baseline phases,

the target behavior does not produce a systematic change in the environment (no consequence). Contingency-learning games can include either social or non-social consequences. That is, adults may be present in the room with the infant during the game and deliver the contingent consequence, or adults may not be present in the room, and the contingent consequence is a non-social change in the environment (e.g., a mobile shaking following the infant's kicking behavior).

During contingency-learning games, researchers evaluate changes in the target behavior within and across phases (e.g., baseline, acquisition, return to baseline) to determine if contingency learning has occurred. Systematic changes (i.e., learning) in the infant target response typically include changes across more than one dimension of the response. Dimensions of the infant response that may change within and across phases include: a) the frequency or rate of responding, b) the inter-response time from the beginning to the end of a session (e.g., acceleration or deceleration), c) the amount of time each response lasts (duration), d) or the magnitude/intensity of the response. Learning is said to occur during the contingency-learning game when the infant engages in the target response more frequently and with acceleration during the acquisition phase, compared with baseline. During return to baseline, if learning was evident during acquisition, the infant may initially engage in a higher rate of the target response compared with the initial baseline or acquisition phase. Following initial high rates, the target response decelerates. The behavior pattern during return to baseline is characteristic of an extinction burst (i.e., rate of behavior increases compared with baseline rate), where previously reinforced behavior no longer produces reinforcement. (Franklin et al., 2014; Lewis et al., 1985; Rovee-Collier & Capatides, 1979). Over the

course of the return to baseline phase, the target response decelerates, and the response may stop occurring. The systematic changes that occur during the return to baseline (i.e., the return to the original contingency, in which no reinforcement was provided) also suggest that the infant is learning the new contingency, that the target response no long produces the expected consequence.

Concomitant changes in nontargeted infant behavior. In addition to changes in the target response, concomitant changes in other infant behavior often occur during reinforcement conditions of contingency-learning games (Dunst et al., 2014), including an increase in sustained gaze toward relevant stimuli (e.g., towards a screen that contingently illuminates when the target response occurs), an increase in smiling, and a decrease in behavior associated with a negative affect (e.g., crying, fussing, whining). Conversely, returning to baseline conditions often produces an increase in behavior associated with a negative affect (Lewis et al., 1985).

Non-social contingency-learning games are arranged so that only the infant target behavior produces a programmed consequence, meaning collateral behaviors (e.g., smiling, crying) do not produce programmed consequences. Therefore, it is unclear what variables explain the occurrence and maintenance of collateral responses during contingency-learning games. One explanation is that a behavior that produces a predicted consequence may elicit respondent infant behavior. Some respondent infant behavior may be observable (e.g., smiling) while other responses may be impossible to observe (e.g., changes in heartrate) without using special instruments (e.g., heart rate monitor). For example, Haley, Grunau, Oberlander, and Weinberg (2008) found that pre-term infants who learned that kicking behavior produced overhead mobile movement engaged

in more smiling behavior and also had an increased heart rate during the contingency-learning sessions, compared with pre-term infants who did not learn the contingency. An alternative explanation is that collateral behavior may be operant, meaning that the infant has experienced a learning history during which behavior (e.g., smiling) has produced reinforcement.

These collateral behaviors, especially smiling, are important side effects of contingency learning, in that caregivers are more likely to engage in CCB when their infant is smiling (Striano, Henning, & Stahl, 2005). The infant smile may function as a signal to the caregiver to begin or to continue interacting (Fagen & Ohr, 1985). Caregivers who engage in more CCBs support infant contingency learning because they expose their infant to more experiences with contingencies (Dunham & Dunham, 1990; J. S. Watson et al., 1982). For example, Dunham and Dunham (1990) found that the amount of time an infant and mother engaged in turn-taking interactions was positively related to the infant's ability to detect the contingency in a contingency-learning game.

Contingency Learning and CCB

An infant's ability to learn new contingencies efficiently through naturally occurring opportunities is essential, as contingency learning facilitates healthy infant development across domains (J. S. Watson, 1972). Some researchers (Goldberg, 1977; J. S. Watson, 1967) have argued that from an evolutionary perspective, the core function of caregiver-infant interactions is to provide the infant with contingent experiences that facilitate the infant's ability to learn contingencies and behave effectively. Caregivers who respond contingently to their infant's behavior become a signal to the infant that contingency-learning opportunities are available. When an infant is motivated to access

contingency-learning opportunities, and their caregiver is a signal to the infant that opportunities are available, the infant may initiate interactions with their caregivers. Thus, some infant social behavior (e.g., initiations with caregivers) may occur *because* caregivers play contingency-learning games with their infant. J.S. Watson et. al (1982) characterized the development of contingency detection (i.e., learning) as follows:

> This ability [contingency detection], which is fundamental to the most basic form of learning, is also thought to be especially important for social relationships, which are formed not on the basis of any inherently distinctive attributes of the caretaker, but because caretakers provide unambiguously contingent stimulation for infants, i.e., they play games with them, in which each occurrence of an infant's response (such as babbling, reaching, nodding) is followed by a stimulus from the caretaker (such as tummy touching, verbalizing, smiling, etc.). (p. 191)

The degree to which caregivers respond contingently to their infant's behavior is strongly associated with infant development, including communication, social emotional, cognitive, and motor development, where more CCB is associated with positive development (Goldstein, King, & West, 2003; Gros-Louis & Miller, 2018; Gros-Louis, West, Goldstein, & King, 2006; Karaaslan & Mahoney, 2015; Lohaus et al., 2005; Mahoney et al., 2007; Murray et al., 2016; Pretzer, Lopez, Walle, & Warlaumont, 2019; Ramírez-Esparza, García-Sierra, & Kuhl, 2017; Rayson, Bonaiuto, Ferrari, & Murray, 2017). The strong associations between contingency learning, concomitant behavior, and CCB suggest that CCB supports infant contingency learning and social-emotional learning (Dunst et al., 2007; Northrup, Libertus, & Iverson, 2017; Tarabulsy et al., 1996; J. S. Watson et al., 1982). The infants improve their ability to detect contingencies, they

may be more able to readily learn, suggesting that contingency learning is a pivotal skill in infant development (Tamis-LeMonda, Luo, & Song, 2014).

Pivotal Behavior

Contingency learning is a pivotal skill in development as the skill supports rapid learning in new and changing environments across the life span. Contingency learning can be described as a *pivotal behavior* (PB), or a behavior that supports an individual's ability to learn new behaviors from naturally occurring (rather than contrived) contingencies in the environment (Koegel, Koegel, Harrower, & Carter, 1999). Some collateral behaviors associated with contingency learning are also PBs. For example, initiating interactions with adults by making eye contact and smiling are PBs and collateral behaviors associated with contingency learning. Sustained eye contact and initiations are skills that precede gaze following and joint attention, both of which are also PBs (Striano & Rochat, 1999). Thus, contingency learning facilitates acquisition of PBs, which may facilitate acquisition of additional PBs (Mahoney et al., 2007; J. S. Watson et al., 1982). See Figure 1 for a schematic of infant pivotal behavior acquisition.

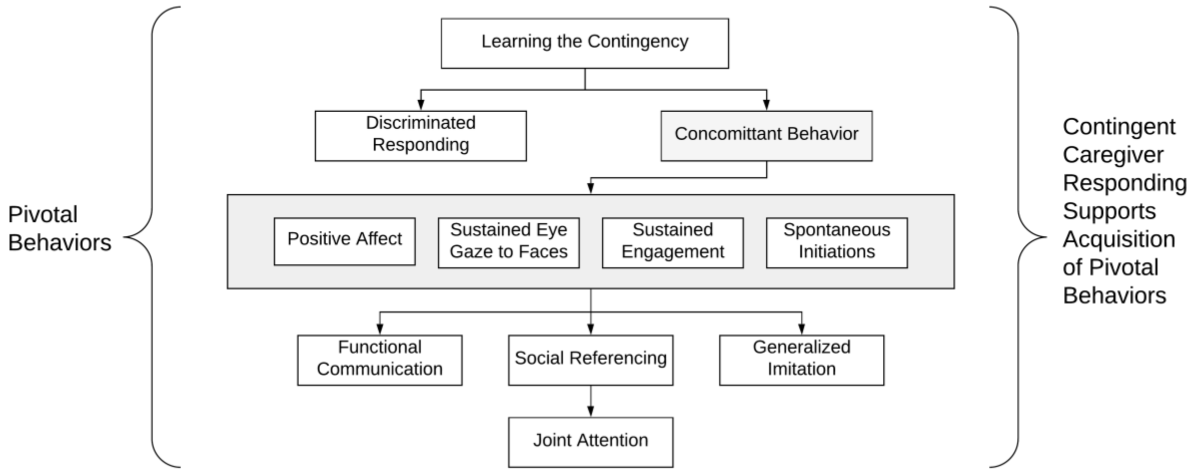

Figure 1. Pivotal behavior flowchart. The flowchart depicts how one pivotal behavior (e.g., learning the contingency) may support learning of other pivotal behaviors.

Infants need PBs in their repertoire in order to learn from the naturally occurring interactions. As each interaction with the environment throughout a day is a potential learning opportunity, infants with PBs have more opportunities to learn throughout the day. In contrast, an infant who is unable to effectively learn in natural contexts may require contrived learning opportunities and miss many naturally occurring learning opportunities.

Pivotal infant behaviors and behavioral cusps. Another concept related to PB is the behavior cusp. A *behavioral cusp* is a behavior change that results in more access to reinforcers in the environment (Bosch & Fuqua, 2001; Rosales-Ruiz & Baer, 1997). For example, when an infant learns to crawl, they are immediately able to independently move to areas of the environment and access reinforcement previously inaccessible to them. Crawling is also PB, in that crawling occurs when an infant is motivated to access a consequence and discriminates that crawling behavior will likely result in access to the

consequence (i.e., reinforcement is available for crawling). To illustrate, an infant may be sitting across the room from their mother. The mother says, “Hi, baby,” while smiling. The infant crawls to the mother, the mother and infant begin playing a game. The infant needs several skills in their repertoire to access the terminal reinforcer of playing the game: the skill of crawling, to be motivated to access their mother’s attention, and the ability to discriminate that attention is available if crawling occurs. The specific topography of the infant’s behavior can be labeled crawling, but the function of the behavior can fall under a much broader category of the PB, “initiation”. An *initiation* is a spontaneous (unprompted) response where the function of the behavior is to recruit social reinforcement (e.g., attention, auditory stimuli) or to escape from aversive stimuli (e.g., communicating the need for a diaper change). An individual who does not exhibit initiations is likely missing opportunities to learn contingencies in the environment and contact reinforcement. For example, CCB supports infant contingency learning, but caregivers are more likely to engage in CCB if there infant is engaging salient behavior to respond to (e.g., initiating interaction, playing with a toy; see Tamis-LeMonda, Luo, & Song, 2014)

Individuals with developmental disabilities often have deficits in more than one area of development (global delays). It is possible to understand why global developmental delays manifest when considering the intersection of PB, learning, and development. If infants are unable to efficiently learn contingencies, they may also engage in fewer overall initiations. Engaging in fewer initiations may have a detrimental effect on development across domains. For example, the age of a toddler’s first steps (motor domain) is associated with their later vocabulary development (communication

domain; Lüke, Leinweber, & Ritterfeld, 2019). An infant who does not engage in initiations may engage in fewer attempts to crawl, which may delay motor development, including walking. Walking is an important developmental milestone. When infants begin walking, they also begin to engage in more interactions with their mothers (Karasik, Tamis-LeMonda, & Adolph, 2014). Infants may engage in more interactions when walking, because their bids for interactions are more effective when they are moving than when they are stationery and bidding for interactions. For example, Karasik, Tamis-LeMonda, and Adolph (2014) found that mothers who had walking infants were twice as likely to respond to their infant as mothers with crawling infants. When the authors analyzed infant behavior during bids for interaction, they found that the difference in maternal responsiveness could be explained by whether the infant was making a bid for interaction while moving or stationary. Infant motor development is essential for facilitating infant-caregiver interactions. In order for infants to develop motor skills, they need to be motivated to move. Infant contingency learning supports infant motivation. Because CCB supports infant contingency learning, and contingency learning is essential for healthy infant development, understanding how CCB is related to contingency learning is warranted. For example, what mechanisms of change best explain the strong associations between CCB and infant development? The mechanism of change may be best understood by first investigating the conditions under which contingency learning occurs. Theories of learning provide conceptual underpinnings that may help synthesize the extant contingency learning research and facilitate identification of characteristics of infant and caregiver behavior that predict optimal infant learning.

Theories of Learning

Theories of learning, such as the operant learning theory (Greer, 2008; Skinner, 1963; Thorndike, 1898), dynamic systems theories (Bronfenbrenner & Morris, 2007; Patterson, 2016; Sameroff, 2010; A. Watson, 1999), and coercive family systems (Patterson, 2016) describe mechanisms of change associated with CCB and infant contingency learning (Bornstein et al., 1992; Tarabulsy et al., 1996). The primary area of agreement across theories is that the interactions between infant and caregiver produce subsequent changes in both infant and caregiver behavior. Operant learning theory is a useful theoretical framework to consider how infants learn contingencies, because operant learning theory is concerned with the study of all environmental variables (both preceding and following a behavior) that are functionally related to the occurrence of a behavior. In addition to identifying variables associated with behavior, researchers are able to manipulate variables to predict, test, and control for changes in a behavior based on operant learning theory. Thus, synthesizing the extant infant learning and infant-caregiver interaction research through an operant learning paradigm may provide new insights into the infant-caregiver relationship.

Operant Learning Theory

Operant learning theory is a theory concerned with operant behavior. A simplified and parsimonious explanation of operant behavior is: if a behavior is occurring, the behaver (individual) has a history of engaging in the behavior, producing a desired effect on the environment. In other words, operant behaviors are those that effect change on the environment. In contrast, respondent behaviors are those that occur in response to a change in the environment preceding the behavior. When a dog smells food, they may

start to produce saliva. Saliva production does not cause a change in the environment. Saliva production occurs because of the past association of smells and eating. Behaviors cannot be classified as respondent or operant by the behavior's topographical features (i.e., the form of the behavior). For example, all saliva producing behavior is not necessarily respondent. Consider a child who does not like math. In the past, the child has spit on his classmate. After spitting, the child was removed from math (i.e., a preferred outcome). In a similar context in the future (motivation to escape math, presence of people who are likely to remove him from class), the child again produces saliva to spit on his classmate. In this example, saliva production is operant, not respondent. Saliva production occurred because it is related to escaping math. Saliva production is neither operant nor respondent without context. Rather, saliva production is an observable behavior that may be either operant or respondent, dependent upon the context in which it occurs. Thus, determining whether a behavior is operant or respondent requires analysis of the context in which the behavior occurred and the learning history of the behaver.

Applied behavior analysis. Applied behavior analysis (ABA) is a branch of behavior analysis that studies socially important behavior, especially operant, human behavior (see Baer, Wolf, & Risley, 1968 for dimensions of ABA). Applied behavior analysts study operant behavior using technologies to isolate the environmental variables that are functionally related to the occurrence of the behavior. The analysis of operant behavior requires the analysis of the functional relations of the three-term contingency (antecedents, behavior, consequences). The variables said to control the behavior are the stimuli present prior to the behavior (antecedents) and changes in stimuli occurring following the behavior (consequences). The three-term contingency is often called the

ABCs of behavior. Manipulation of antecedents and consequences allows for prediction and control of behavior. Because contingency learning is operant behavior, variables associated with contingency learning can be studied with methods similar to those used to study other topographies of operant behavior.

Both antecedents and consequences are related to the occurrence of a behavior, albeit in different ways. Antecedents are related to behavior in that they are variables that make the exhibition of a behavior more likely, due to the individual's current state of motivation (motivating operations). Antecedents are function as signals (discriminative stimuli) to the individuals that a behavior is likely to work. Antecedents are functionally related to a behavior due to the individual's history of engaging in the behavior in the presence of the antecedents and due to the changes in the environment that occur immediately following the behavior (i.e., consequences). Consequences that follow a behavior and are functionally related to an increased occurrence of the behavior are called reinforcing consequences.

Antecedents. Two types of antecedent stimuli are relevant to contingency learning. Stimuli that are present in the environment when a behavior occurs and produce a reinforcing consequence function as signals to the behaver that the same behavior is likely to be effective (result in a reinforcing consequence) in the future when those stimuli are present. Such stimuli in the environment that signal the availability of reinforcement are called *discriminative stimuli*, or SDs. When the signal is absent, the likelihood that reinforcement will follow a behavior is lower, and exhibition of the behavior may be less likely.

The current motivational state of the individual is a second antecedent variable that affects the likelihood of a behavior occurring, characterized by a state of satiation or deprivation. An individual who is in a state of deprivation (e.g., hungry) is more likely to engage in a response that in the past has successfully removed the sensation of hunger (e.g., eating food removes hunger). When hungry, eating will occur because it has been effective at getting rid of hunger in the past. An infant who has not engaged in caregiver-infant interactions for a period of time may be in a state of deprivation of attention and may be motivated to engage in behavior that in the past has been effective at recruiting attention (e.g., crying, vocalizing). Motivational states have temporary effects on the value of reinforcement, meaning that when states of deprivation or satiation increase or decrease, the momentary likelihood of a given behavior changes as a function of the consequential value (Michael, 1982). When an individual is hungry, removing hunger is valuable, making eating behavior more likely to occur. After eating, the individual is no longer hungry, therefore the value of removing hunger is diminished, making eating behavior less likely to occur.

Reinforcement. Reinforcement occurs when contingent consequences strengthen behavior, meaning that the behavior is more likely to occur in the future. Similar to the distinction between operant and respondent behavior, reinforcement cannot be categorized based on the physical features and topography of the stimulus change. That is, reinforcement is defined by its effect on the future occurrence of behavior. The same stimulus may be more or less reinforcing across individuals or may be more or less reinforcing for the same individual at different points in time. For example, for one infant, a certain song may be preferred and function as an effective reinforcer, while for

another infant, the same song may be aversive and not function as a reinforcer. Further, the song may be more or less reinforcing for the same infant depending on the infant's current motivational state. Although the reinforcing value of stimuli is dynamic (i.e., without a fixed value), behavior analysts are able to identify hierarchies or ranges of reinforcing stimuli and manipulate environmental events to increase or decrease the value of reinforcement.

Parameters of reinforcement. The degree to which a given stimulus has a reinforcing effect on a given behavior can be manipulated by changing parameters (e.g., delay, quality, magnitude) of the stimulus. For example, a reinforcer delivered immediately following behavior (within a few seconds) is more effective at increasing behavior than the same stimulus delivered after a delay. The quality of the stimulus also influences the reinforcing effects of stimuli. One way of identifying stimuli of different values includes preference assessments, which can systematically identify the most valuable stimulus to use as reinforcement during skill acquisition procedures. A stimulus that is delivered contingent on the occurrence of a behavior may be very high quality in the first instance, but the quality may diminish with each delivery of the same stimulus. For some stimuli, the reinforcing quality does not diminish with repeated access. Finally, the magnitude of the stimulus can alter its reinforcing effects. For example, if a child's favorite treat is an Oreo, giving them a tiny piece of an Oreo will strengthen behavior that produces access to it. However, it is possible that the reinforcing effect will be greater if you give them an entire Oreo (instead of just a tiny piece). Typically, but not in every case, the shortest delay from behavior to consequence (i.e., immediacy), highest quality, and largest magnitude are parameters best able to strengthen a behavior.

Given the importance of an individual's past experiences with behaving effectively, operant behavior is described in terms of a behaver's learning history, where the successes or failures (consequences) of engaging in the behavior in past similar contexts (including motivational states and signaling stimuli) explain the occurrence of the behavior in the present (Cooper, Heron, & Heward, 2007) and predict future occurrences of behavior. Behavioral scientists determine the functional relations between a given behavior and the variables in the environment through experimentally manipulating antecedents and consequences to predict and control the future occurrence of behavior. Experimental manipulations of infant behavior indicate that infants as young as 2 days old engage in operant behavior (Moon & Fifer, 1990).

Infant Discriminated Responding

Discriminated responding is defined as behavior that occurs more frequently in the presence of certain stimuli because of a history of reinforcement associated with those stimuli. Discriminated responding is important when considering infant learning because it is directly related to an infant's ability to learn contingencies and behave effectively (i.e., engage in behavior that is likely to result in reinforcement). The inability to discriminate contingencies is a barrier to learning and development. For example, failure to effectively discriminate is related to poor developmental outcomes (Northrup et al., 2017) and is characteristic of some developmental disorders (Bailey, 1981), including autism spectrum disorder (Ploog, 2010). Effective discrimination is characterized by a balance of correctly identifying situations in which reinforcement is available, or unavailable, including the ability to discriminate novel stimuli as signals for that share similar characteristics to stimuli from the individual's learning history that signal

reinforcement. Ineffective discrimination may manifest in two ways: a) the individual may incorrectly identify stimuli that signal reinforcement (e.g., over-generalization); b) only discriminate a specific feature of a stimulus (e.g., over-selectivity). When an individual is able to discriminate the contingencies associated with successful behavior effectively, they are able to behave more systematically, resulting in more access to reinforcement (Dunst, Raab, Trivette, et al., 2007; Northrup, 2017; Northrup et al., 2017; Tarabulsy et al., 1996).

Discriminated Responding

Infants learn to engage in discriminated responding through repeated experiences with behaving and (a) contacting reinforcement in the presence of S^Ds and (b) not contacting reinforcement in the absence of S^Ds. One example of infant discrimination learning is infant discrimination of caregiver language. That is, bilingual infants experience interactions with caregivers who speak two or more languages. Through interactions, bilingual infants learn to engage in discriminated responding, where they are able to switch between communicating in one language with one family member, and another language with another family member (Genesee, Nicoladis, & Paradis, 1995). This type of discriminated responding is also called *interlocutor sensitivity*, or *code switching*. A failure to code switch may be a sign that the infant has a language delay or other disability (Paradis, Crago, Genesee, & Rice, 2003) which may be related to an inability to discriminate.

Development of discrimination skills begins in infancy and continues across the lifespan. Discriminated responding is evident in newborn infants. For example, Moon and Fifer (1990) found that 2-day-old infants discriminated that their own nutritive sucking

behavior would differentially result in either the presentation of an auditory stimulus (e.g., sound of the infant's mother's voice) or the removal of the currently playing auditory stimuli. The consequence that followed sucking was dependent on the auditory stimulus present when sucking behavior began. A session began when an infant was not sucking on a hospital feeding nipple. At all points in the session, when the infant was not sucking on the nipple, a recording with a string of auditory stimuli played through infant headphones. The auditory stimuli were of a monotone male voice. The voice alternated between 4-s patterns of two distinct syllable sounds (i.e., 'pat'; 'pst'). Whenever the infant sucked on the nipple, an immediate change in stimuli occurred (consequence). The type of consequence that followed sucking was contingent on the auditory stimulus present when sucking initiated, either 'pat' or 'pst'. One consequence was the presentation of the infant's mother's voice. The other consequence was removal of all auditory stimuli. The stimulus change (mother's voice or removal of auditory stimuli) remained constant for the duration of infant sucking. For example, the syllable 'pat' was associated with maternal voice. If the infant began sucking when 'pat' was playing, the auditory stimuli immediately switched to a recording of the mother's voice and continued playing until the infant stopped sucking. If the infant began sucking while the 'pst' recording was playing, all sound was immediately removed, and silence continued until the infant stopped sucking. Each infant engaged in the feeding session for one 18-min session.

Infants engaged in more sucking in the presence of the stimulus that signaled the availability of the maternal voice. These results suggest the infants engaged in discriminated responding (i.e., more behavior in the presence of one of the stimuli),

preferred the mother's voice over silence, and that infant contingency learning occurred rapidly (< 12 min). Moreover, the duration of infant sucking increased across the session in the presence of the maternal voice signal and decreased across the session in the presence of the silent signal.

In Moon and Fifer (1990), the on-set of infant sucking behavior produced an immediate environmental change in every instance. The type of change was dependent on the antecedent condition (i.e., syllable form). Infants are also able to discriminate the difference between conditions in which their behavior produces a change in the environment, and conditions in which their behavior does not produce a change. For example, Rovee-Collier and Capatides (1979) evaluated infant kicking and mobile movements during a contingency learning game. During sessions, infants laid on their backs in their crib at home with mobiles hanging overhead. Researchers placed patterned blocks next to the overhanging mobile to signal the availability of reinforcement (mobile movement) for kicking. For example, one set of blocks was present during sessions where kicking produced reinforcement. A different set of blocks with a different pattern was present during sessions when kicking did not produce reinforcement (no mobile movement. During baseline, infant kicking did not produce mobile movement in the presence of either set of blocks. One 90-s session was completed for each set of patterned blocks. After baseline, the set of blocks associated with the fewest infant kicks during baseline was used during subsequent reinforcement sessions (where infant kicking produced mobile movement). The other set of blocks was used in sessions where infant kicking did not produce mobile movement. Results indicated that during the reinforcement condition (where infant kicking produced mobile movement), the rate of

infant kicking increased compared to baseline. Infant kicking during the no reinforcement condition maintained similar responding to baseline. Infant response patterns suggest infants learned the contingency that kicking produced mobile movement in the presence of the blocks that signaled availability of reinforcement.

Supporting Contingency Learning

The extant literature suggest infants are able to learn contingencies from birth and are able to learn how to discriminate rapidly when environmental arrangements are optimized for discrimination learning (Lewis et al., 1985; Lohaus et al., 2005; Moon & Fifer, 1990; Rovee-Collier & Capatides, 1979). The literature also provides guidance for arranging environments to enhance contingency learning. Contingency learning occurs faster when infants have repeated opportunities to experience the ABC contingency and when there are salient and simple cues (Northrup, 2017; Rovee-Collier & Capatides, 1979). The parameters of reinforcement (e.g., immediacy, quality, magnitude) also predict the speed at which an infant learns. For example, both Moon and Fifer (1990) and Rovee-Collier and Capatides (1979) delivered conjugate reinforcement contingent on infant behavior. *Conjugate reinforcement* is characterized by a change in stimulus that immediately follows a behavior and is directly related to the duration, frequency, or magnitude of the behavior (Lindsley, 1963). Rovee-Collier and Capatides (1979) designed the mobiles in the experiment to provide conjugate reinforcement to the infant during the contingent condition by attaching a string to the infant's foot. Thus, when the infant engaged in kicking behavior, the degree to which the mobile moved was directly related to characteristics of the kick. If the infant kicked hard, the mobile moved more. If the infant kicked for a long duration, the mobile moved for a similar duration, similar to

infant sucking behavior where the consequence remained in place as long as the infant continued to engage in sucking behavior (Moon & Fifer, 1990). In other words, the dimensions of the infant's behavior directly corresponded to changes in the mobile movement. The one-to-one correspondence of the antecedent, behavior, and consequence supports an infant's ability to detect the contingency.

Lewis et al. (1985) evaluated the effect of contingent versus non-contingent reinforcement on infant arm movement. Infants in three age ranges (10, 16, and 24 weeks) were matched for age and gender into pairs, and then one subject from each pair was randomly assigned to either a contingent or a non-contingent group. Infants sat in an infant chair, oriented towards a projection screen 45 cm away. A sound speaker was situated above the infant's head and was connected by a string to a Velcro cuff on the infant's wrist. Contingent on arm movement, infants in the contingent group activated visual stimuli on the screen and an auditory stimulus from the speaker for 3 s. Infants in the non-contingent group had no control of the environment but experienced a matched rate of reinforcement to their peer. That is, after the infant in the contingent group completed a session the matched peer completed a session in which stimuli were presented on a schedule that matched the temporal locus within session from the previous peer (a yoked control). Thus, the amount of reinforcement and temporal locus of reinforcement within a session were equated across each infant pair. All infants completed one session. The length of each session depended on infant behavior during the session. Sessions continued until one of the following conditions was met: a) fussiness for 30 consecutive seconds, b) eyes closed for 30 s, c) the infant did not move their arm for 2.5 min. Sessions ended because of fussiness for 95% of sessions. Each

session began with a 1-min baseline for all participants, (the authors did not describe what occurred during baseline), followed by either contingent or non-contingent reinforcement session depending on group assignment.

Infants that were 16-weeks and 24-weeks old in the contingent group engaged in longer sessions, more arm waving, and more smiling (concomitant behavior change). Within-session analyses revealed an acceleration of arm waving over the course of the session, suggesting infant learning. In contrast, 10-week-old infants did not differ in smiling or arm waving across contingent and non-contingent groups; however, a statistically significant difference was found between contingent and non-contingent groups for length of session, where 10-week-old infants in the contingent group engaged in longer sessions than 10-week-old infants in the non-contingent group. The results suggest contingent sessions were somehow related to a delay in fussiness, even in the absence of behavior indicating contingency learning (no systematic increase in arm waving). The results also suggest that contingency-learning games not only produce an increased occurrence of a target response but also produce concomitant changes in behavior including increases in positive affect (smiling) and sustained attention (length of session). Infants who engaged in the longest sessions also had the most learning opportunities. Similar to Moon and Fifer (1990) and Rovee-Collier and Capatides (1979), infant behavior produced reinforcement for the contingency group directly, where the infant arm triggered the apparatus response. One difference in reinforcement type was that the arm movement produced a fixed duration of stimuli (3 s), rather than reinforcement matching the duration of the infant behavior.

An individual's ability to behave effectively is directly related to the degree in which the individual is able to engage in discriminated responding (Ploog, 2010). Contingency detection in natural-learning environments is more complex than in contrived environments, such as the contingency-learning games used in Rovee-Collier and Capatides (1979), Moon and Fifer (1990), and Lewis et al. (1985). Natural environments include a multitude of stimuli that may limit an infant's ability to discriminate the relevant stimuli associated with a contingency. Thus, natural environments require complex discrimination- and contingency-detection skills. Infants learn complex discrimination and contingency detection through the many daily interactions with their environment, including interactions with caregivers. Caregivers have an essential role in supporting their infant's development. There is evidence, for example, that CCB during natural play interactions supports infant performance in contrived and naturalistic contingency-learning games (Dunham & Dunham, 1990; Zmyj & Marcinkowski, 2017). While caregiver behavior influences infant behavior and development, infant behavior (e.g., vocalizations, pointing, smiling, positive affect) influences caregiver behavior (Albert, Schwade, & Goldstein, 2018; Karasik et al., 2014; N. A. Smith & Trainor, 2008). Thus, caregivers support infant learning and infants support caregiver learning.

Caregiver-Infant Relationship

Bi-Directional Influence of Change

The infant-caregiver relationship is characterized as sharing a bi-directional influence, where a change in either the infant's behavior or the caregiver's behavior produces a systematic effect on the occurrence of the other's behavior (Goldberg, 1977;

Pretzer et al., 2019). The infant-caregiver relationship suggests that a caregiver's responsive behavior towards their infant reinforces the infant's behavior; the infant's subsequent behavior strengthens the caregiver's behavior. Caregivers who engage in more CCBs provide more reinforcement to infant behavior and more opportunities for their infant to experience and learn how their own behavior is related to changes in the environment. That is, the infant may be better able to detect the contingency because they have more experiences with the ABC pattern. Contingency detection, in turn, promotes an infant's spontaneous behavior (e.g., intentional communication acts) that is likely to elicit CCB (Cohn & Tronick, 1988; Dunst et al., 2014; Van Egeren, Barratt, & Roach, 2001). An infant who engages in frequent communication provides frequent salient signals (i.e.,antecedents) to their caregiver. The infant's salient cues may support the caregiver's detection of the contingency that their own behavior is functionally related to their infant's response.

Collateral effects observed during contingency-learning games (e.g., sustained attention; positive affect) in infants are also observed in caregiver behavior (Dunst, Raab, et al., 2010). A positive feedback loop can emerge during infant-caregiver interactions where more infant behavior produces more CCB, resulting in more infant behavior (Gros-Louis & Miller, 2018). The transactional model of development (Sameroff & Fiese, 2000) and other dynamic learning theories, describe and study the bi-directional relationship between infants and caregivers. The overall effect is that more positive behavior from the caregiver or the infant produces more positive behavior from the other partner, producing a beneficial cascading effect (Innocenti, Roggman, & Cook, 2013;

Sameroff & Fiese, 2000). See Figure 2 for an example of the cascading effect of positive infant-caregiver interactions.

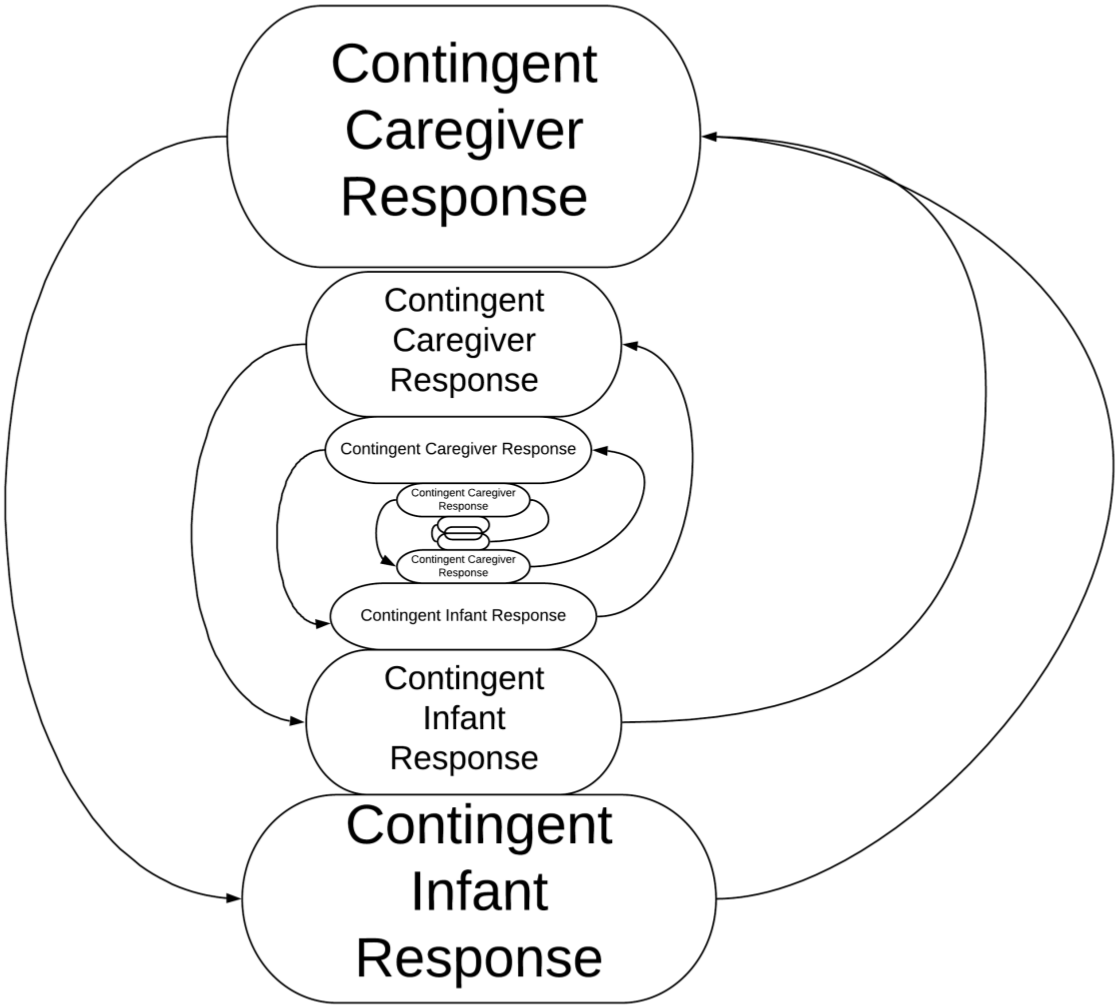

Figure 2. Positive cascading effect of infant-caregiver contingent responses.

Infant-Caregiver Bi-directional Relationship Analysis

An analysis of infant-caregiver interactions indicates that while CCB reinforces infant behavior, infant behavior in response to caregiver behavior reinforces the caregiver's behavior, indicating a bi-directional influence on behavior. Analyzing the variables that surround infant and caregiver interactions may help explain how the bi-

directional relationship develops (see Figure 3). Operant behavior can be analyzed as a behavioral unit (ABC) which includes analysis of the antecedents that precede behavior, the behavior of concern, and the consequence that immediately follows the behavior (Cooper et al., 2007). For example: (a) an infant begins to babble while her mother is facing away; (b) the infant's mother turns around and vocally responds to her infant using vocalizations that are exaggerated and with warm affect (i.e., parentese); after the mother turns around and responds to her infant (c) her infant begins smiling, laughing, and babbling more. In the future, the mother turns to face her infant and responds in a comparable manner when her infant babbles (Figure 3a). In this example, the unit of analysis only evaluated one behavior (i.e., the mother's baby talk). The mother's behavior contacted reinforcement when her infant smiled and laughed (evidenced by the mother's continued behavior in the similar circumstance in the future).

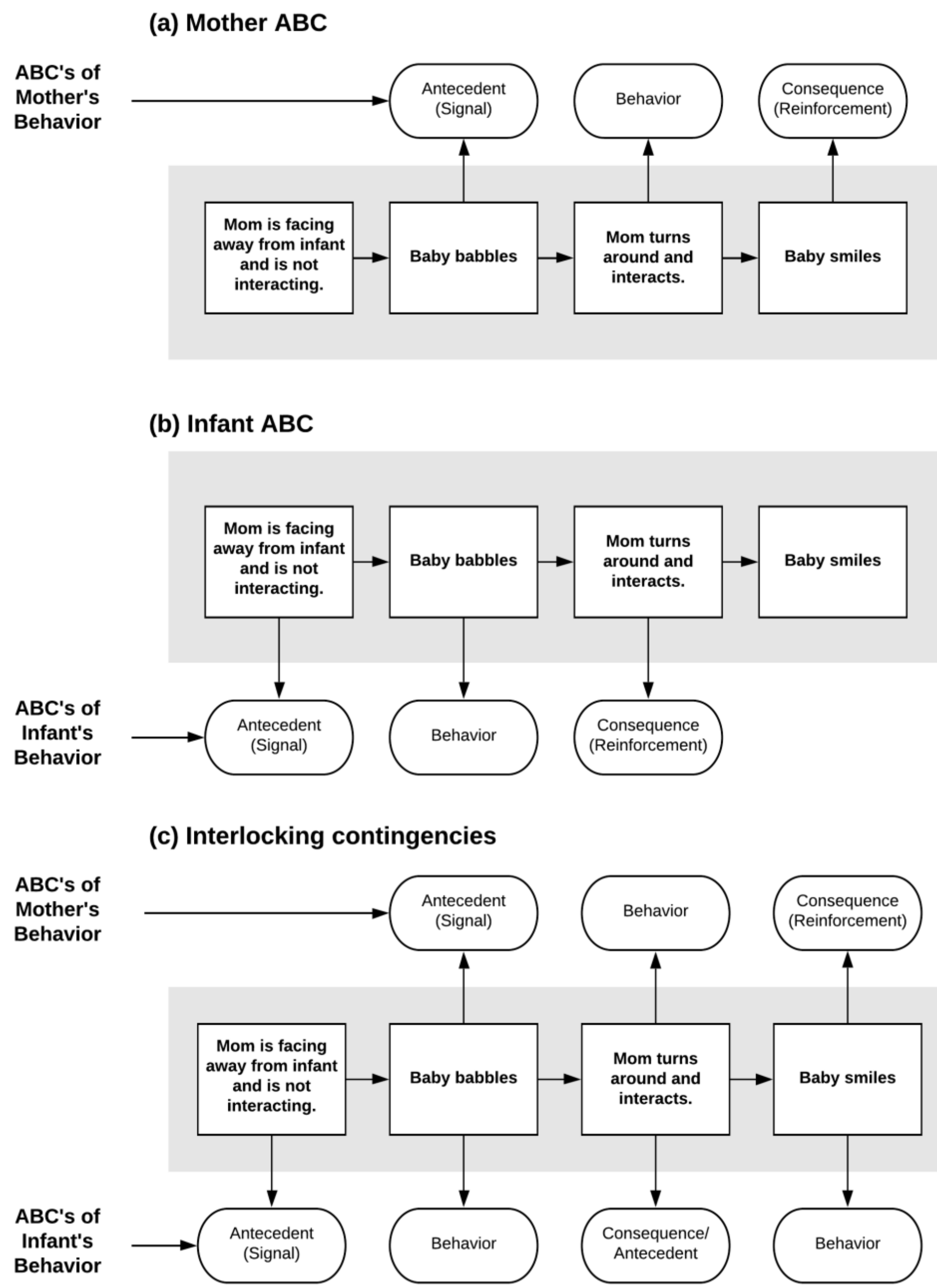

Figure 3a-c. Caregiver-infant interlocking contingencies. 3a. ABC analysis of mother's behavior. 3b. ABC analysis of infant's behavior. 3c. Analysis of interlocking contingencies for mother and infant.

The infant’s behavior can also be analyzed using the ABCs at the behavioral unit (Figure 3b). The mother facing away from her infant functions as an antecedent (signal and potential state of brief deprivation) for the infant to engage in babbling behavior. When the infant babbles (behavior), the mother turns and gives the infant attention (consequence). The infant’s babbling behavior is reinforced. The infant-caregiver relationship is bi-directional, sharing interlocking contingencies (Glenn, 2004), where one individual’s behavior may function as an antecedent or a consequence for another individual’s behavior, and vice-versa (Figure 3c).

The bi-directional relationship also entails that undesirable behavior from either caregiver or child can initiate a feedback loop producing a negative cascading effect (J. D. Smith et al., 2014). The coercive family process model (Patterson, 2016) suggests that when a child is unable to address needs through appropriate means, either due to an inability to communicate or due to a caregiver who does not respond or responds ineffectively to appropriate communication, the child may instead engage in maladaptive behavior to get their needs met. For example, a toddler who has not received attention from his mother for some time is in a state of attention deprivation, and thus motivated to access her attention. He engages in some appropriate behavior to access her attention, but his bids for attention are ineffective; however, he is still in a state of deprivation for attention. Motivated to access attention, he engages in a tantrum, screaming and crying on the floor. His mother rushes into the room. Seeing her toddler in distress is aversive and the mother is motivated to comfort him. The mother engages in behavior that in the past has comforted her toddler (i.e., resulted in the toddler stopping the tantrum). His mother’s soothing behavior was effective in stopping her toddler’s tantrum. Crying,

though not a pro-social way to access his needs, functioned to access attention. If crying is a more effective behavior than age appropriate communication (e.g., looking towards, reaching, pointing, babbling etc.), crying is more likely to occur than appropriate communication until the toddler learns a more effective means to get his needs met. Both mother and toddler reinforced each other's behavior (Figure 4).

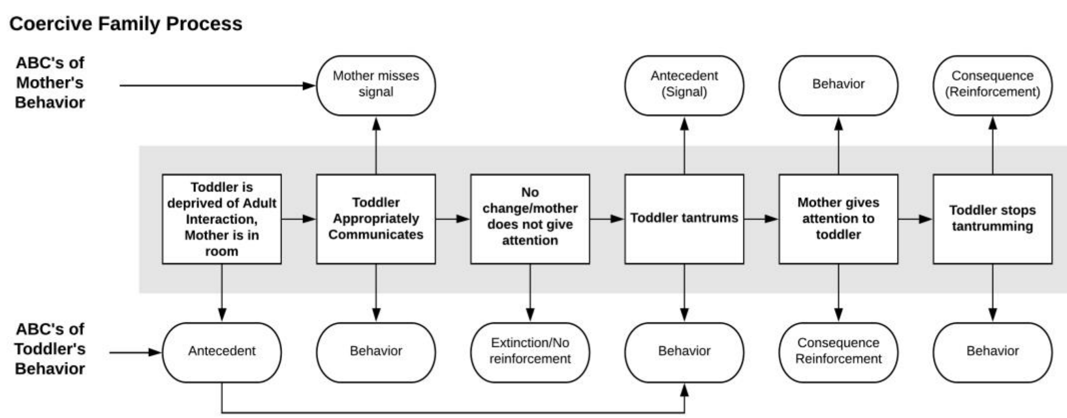

Figure 4. Coercive family process interlocking contingencies.

Developmental learning theories, including operant learning theory and non-behaviorally-based theories, suggest than infant learning occurs through the infant's interactions with their environment, including their caregivers. The bi-directional relationship supports both infant and caregiver contingency learning. Contingency-learning games produce an increase in reinforced behavior, and also an increase in collateral behavior, including increased positive affective behavior and sustained attention (Dunst, Raab, & Hamby, 2017; Lewis et al., 1985; Mahoney et al., 2007).

Infant Vocalizations and CCB

Caregiver's respond differentially to dimensions of infant vocalizations and other behavior (Gros-Louis & Miller, 2018; Pretzer et al., 2019; Wu & Gros-Louis, 2015). Infant behavior preceding CCB (i.e., antecedents) reveal consistent categories of behavior that are most effective for infant recruitment of caregiver attention. In an analysis of daily infant-caregiver interactions during daily routines, Pretzer et al. (2019) found that caregivers were most likely to respond following distressed infant vocalizations. Caregivers were more likely to respond vocally to infant vocalizations that included gestures (e.g., reaching, pointing). When infant vocalizations include gestures, caregivers were more likely to engage in labeling utterances than non-labeling utterances (Lloyd & Masur, 2014; Masur & Olson, 2008; Olson & Masur, 2013; Wu & Gros-Louis, 2015). Early infant use of gestures is one of the best predictors of language outcomes. Infant gestures may function as antecedent signals to their caregivers not only to respond, but also how to respond *effectively*.

Infant vocalizations are bi-directionally related to CCB. That is, an infant's vocal production is related to systematic changes in CCB, and CCB is related to systematic changes in infant vocal production (Goldstein & Schwade, 2008; Gros-Louis & Miller, 2018; Gros-Louis et al., 2006; Pretzer et al., 2019). Infants engage in more vocalizations following CCB, but not following non-contingent caregiver attention (Goldstein et al., 2003; Pelaez, Borroto, & Carrow, 2018). CCB is functionally related to the maturity of infant vocalizations (Franklin et al., 2014; Goldstein et al., 2003). Gros-Louis and Miller (2018) recorded all infant and caregiver behavior during naturalistic play interactions, and analyzed the moment-by-moment relationships between infant vocalizations and

CCB. Infants were more likely to produce a mature vocalization (consonant-vowel) than a less mature vocalization (vowel-like) following CCB of the infant's previous vocalization, regardless if the original infant vocalization was a consonant-vowel, or vowel-like (Goldstein et al., 2003).

Caregivers are more likely to respond to infant vocalizations that are more speech-like (e.g., canonical babble) compared to vocalizations that are less mature (Gros-Louis & Miller, 2018; Gros-Louis et al., 2006; Pretzer et al., 2019). Infants who engage in less frequent speech-like utterances and/or are not engaging in communicative gestures compared with other infants provide fewer signals to their parent to respond with labeling or imitation responses (Wu & Gros-Louis, 2015). Infant signaling may be associated with the frequency of CCBs, wherein an infant who engages in infrequent signaling may experience fewer contingent interactions with caregivers because the caregiver is not receiving signals to respond.

Vocal Imitation

Imitation is a type of CCB that supports infant development. Imitation (also described in the literature as mirroring or synchrony) is a response occurring in close temporal proximity (1 s to 5 s) and matching the topography of another individual's behavior. Maternal vocal imitation is positively associated with later vocabulary size, and the association is even stronger when interactions include positive maternal affective characteristics (e.g., smile, touch, parentese; see Masur & Olson, 2008). In a review of 22 studies evaluating the relationship between maternal imitation and infant vocal production, Dunst, Gorman, and Hamby (2010) found that all CCB were significantly

related to infant vocal production; maternal imitation was the most strongly associated type of CCB.

Bigelow and Walden (2009) conducted a clinic-based face-to-face experiment to evaluate the relationship between maternal and 4-month-old responses during *natural-interaction*, *no-interaction*, and *non-contingent interaction* conditions. When mothers engaged in vocal imitation during the *natural-interaction condition*, infants engaged in more vocalizations, and increased duration of vocalizations, frequency of infant initiations, and frequency of infant smiling. When mothers provided no attention in the *no-interaction condition*, the frequency of infant behavior to recruit their mother's attention was strongly associated with the frequency of maternal imitation during the *natural interaction phase*. The frequency of maternal behavior described as "maternal warmth" (e.g., smiles, facial gaze, parentese, and praise) during the *natural-interaction phase* was not significantly related to infant attention seeking behavior during the *no-interaction phase*. The relationship suggests mothers who engaged in more vocal imitation may have supported their infant's ability to discriminate that their own attention getting behavior was likely to contact reinforcement. Moreover, concomitant changes typically observed in contingency learning also occurred during *vocal-imitation sessions*. Results are consistent with descriptive (Tamis-LeMonda et al., 2001) and experimental manipulations of maternal behavior (Pelaez et al., 2018; Pelaez, Virues-Ortega, & Gewirtz, 2011) indicating contingent responses, especially imitation, are functionally related to changes in infant behavior.

The bi-directional nature of the caregiver-infant relationship suggests that the infant's behavior in response to CCB supports the caregiver's ability to detect the

contingency. Field (1977) evaluated face-to-face interactions between 14-week-old infants and their mothers to identify differences in infant gaze shifting across maternal behavior conditions. Maternal behavior conditions included three 3 min face-to-face interactions: a) control, b) imitate, and c) keep attention. During the *control condition*, the researcher instructed the mother to interact as though they were at the dinner table at home. During the *imitation condition*, the researcher instructed the mothers to mirror all infant motor and vocal behavior. During the *keep attention condition* the researcher instructed the mothers to attempt to keep their child's continuous attention during the interaction period. In two conditions (*control condition* and *attention keeping condition)* the researcher did not provide the mothers with any behavior specific guidance. In one condition *(imitate condition*) the researcher instructed the mother to imitate all infant behavior. All participants completed the *control condition* first. Next, participants either completed the *imitation condition* or the *attention keeping condition*. Investigators counterbalanced the latter two conditions to control for a sequencing effect.

The results from the experimental arrangement produced some interesting findings. First, mothers in the *imitation condition* engaged in the most contingent response but engaged in the fewest interactions overall. Mothers engaged in interactions the most during *attention keeping condition.* Infants engaged in the least amount of gaze avoidance during the *imitation condition*, and the most gaze avoidance during the *attention keeping condition*. Furthermore, mothers who completed the *imitation condition* prior to completing the *attention keeping condition* engaged in more imitative responses during the *attention keeping condition* than mothers who completed the *imitation condition* last. The results suggest that mothers who completed the *imitation condition*

first, may have learned that their own imitative behavior was an effective strategy for accessing and maintaining their infant's attention. The results also suggest that the characteristics of caregiver interaction (contingent responses) are more important than overall frequency of interactions. CCB was strongly associated with sustained infant gaze. Sustained infant gaze is a common collateral effect of contingency learning (Lewis et al., 1985; Rovee-Collier & Capatides, 1979). Sustained dyadic attention is an essential pre-requisite behavior for the development of other important communicative and social skills such as social referencing and joint attention (Kasari, Gulsrud, Wong, Kwon, & Locke, 2010). The findings also demonstrate the bi-directional influence of change between mother and infant. That is, when the mother imitated her infant, the infant was more likely to continue to attend to their mother. Because the infant engaged in sustained attention with their mother following imitation, the mother was more likely to engage in imitative responses in the *keep attention* condition when the mother was motivated to engage in behavior to keep their infant's attention.

Vocal Imitation as Conjugate Reinforcement

Vocal imitation is a conjugate consequence. When vocal imitation follows a vocal behavior and the vocal behavior occurs more in the future, vocal imitation is conjugate reinforcement. CCB in the form of vocal imitation is a conjugate consequence where the CCB is delivered immediately and the form matches the infant's vocal response in duration, prosody, syllables. Conjugate reinforcement is an effective type of reinforcement frequently included in contingency-learning games (Lohaus et al., 2005; Moon & Fifer, 1990; Rovee-Collier & Capatides, 1979). Conjugate CCB, such as vocal and gestural imitation, may facilitate infant discrimination by making the relationship

between infant behavior and environmental change more salient (Gergely & Watson, 1999). Imitation is a unique category of CCB, in that it provides conjugate reinforcement, which may explain why imitation supports an infant's discrimination of contingencies (Bigelow & Waiden, 2009). In contrast, CCB such as labeling a child's behavior provides related but asymmetric reinforcement. That is, when the child points to her duck, the caregiver says "Duck, quack" or, "it's a duck!". Labeling-CCB also supports infant development. For example, labeling is associated with vocabulary development (Wu & Gros-Louis, 2015). While labeling and other asymmetric CCB support development, they may not be as effective during contingency-learning games as a symmetric caregiver response such as vocal imitation (Bigelow & Waiden, 2009).

Strengthening CCB and Infant PB

The infant-caregiver bi-directional relationship entails that insufficient responding by either infant or caregiver predicts a detrimental effect on each other's behavior. In situations where either an infant is engaging in too few PBs to elicit caregiver interactions, or a caregiver is engaging in too few CCBs, interventions that target either infant acquisition of PB, or caregiver acquisition of CCB are warranted. Theories of infant learning suggest that modifications to the environment (more CCB) will support infant-contingency detection. Caregiver training studies targeting change in CCB found that CCB was only predictive of positive child development outcomes if the child was also engaging in PB (e.g., positive affect, initiations) during sessions (Chiu, Lin, Mahoney, Cheng, & Chang, 2017; Karaaslan & Mahoney, 2015). The findings suggest that PB may mediate the benefits of CCB on child development. The mediating role of PB may explain why in some cases, caregiver training produced an increase in CCBs, but

did not produce a corresponding increase in child outcomes (L. R. Watson et al., 2017). If CCB does not produce a reinforcing infant behavior, operant learning theory suggests that over caregiver behavior will decrease over time. In contrast, if caregivers engage in more CBB following training, and their infant engages in reinforcing consequences following CBB, the caregiver is more likely to continue to engage in CBB over time. See Figure 5 for a schematic of caregiver training and positive or negative feedback loop potential. The role of PB and CCB is notable given many caregiver trainings target responsivity and CCBs. Researchers should design interventions to increase both CCB and infant PB (if absent from the infant's repertoire).

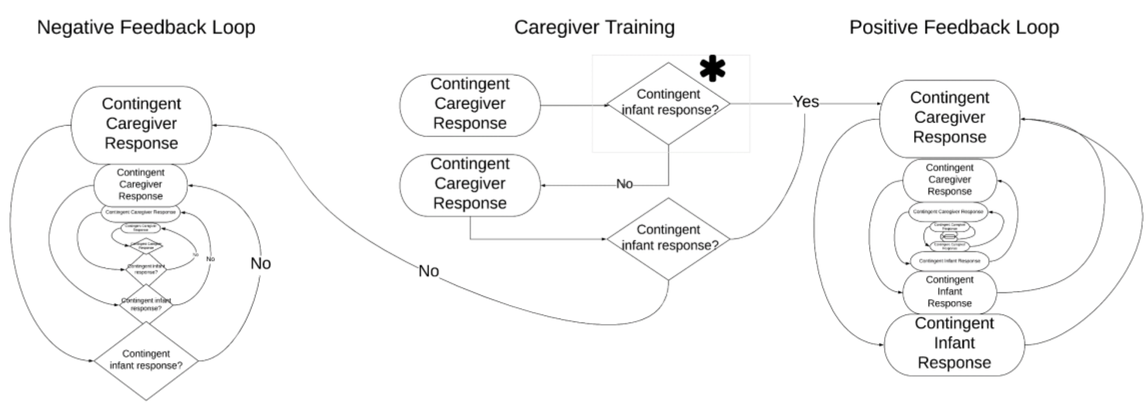

Figure 5. Caregiver training and caregiver-infant feedback loops. The asterisk denotes the pivotal behavior that leads to a learning cascade.

Infant Acquisition of Pivotal Behaviors

Optimal arrangements for infant contingency learning are arrangements where the infant experiences the three-term-contingency multiple times and with 100% fidelity in quick succession; meaning that in the presence of certain antecedents, a given behavior

almost always produces a given consequence (Moon & Fifer, 1990; Rovee-Collier & Capatides, 1979). Despite imperfect contingencies (contingencies with intermittent reinforcement) in natural contexts, most infants are still able to learn contingencies (Northrup, 2017). Contrived interactive opportunities, such as contingency learning games, provide explicit opportunities for the infant to learn contingencies rapidly.

Typically developing infants learn contingencies through everyday interactions; however, contingency learning can occur faster when the environment is modified to isolate the effects of the behavior and consequence (Tarabulsy et al., 1996). For example, Raab et al. (2009) taught three preschool children with severe cognitive impairment a target response during a contingency-learning game. In a secondary analysis of baseline and acquisition sessions, the authors estimated it would take between 105-150 trials of the contingency game to evoke 100-contingent responses from the participants. In contrast, if only non-contingent reinforcement was delivered, it would have required 600-3,000 trials of the game to evoke100-contingent responses. The results suggest that contingency-learning games may be an efficient approach to support contingency learning, compared with relying on naturally-occurring opportunities. Contingency learning occurs faster when many repeated learning opportunities occur in short succession. Thus, contrived opportunities may be beneficial for some infants.

One purpose of a contingency-learning game is for the infant to experience repeated and easily detected patterns between infant behavior and environmental changes that immediately follow infant behavior. A second purpose is to design the game so that it is likely to produce positive collateral effects, such as an increase in PB. The extant evidence suggests that contingency learning is enhanced when: (a) conjugate

reinforcement is delivered following an infant response, (b) the reinforcement is delivered immediately following a response, and (c) the infant experiences repeated patterns of the ABCs with high fidelity, meaning the same antecedent is present when a behavior occurs, and the reinforcement is delivered following every exhibition of the infant's target response.

Target Responses to Enhance Infant Discrimination Learning

A vocal-imitation game may be an optimal contingency-learning game for infant and caregiver. Vocal imitation is a form of reinforcement than can be delivered immediately and frequently. The infant may satiate on certain reinforcement (e.g., food reinforcers) but may be less likely to satiate on vocal imitation as reinforcement (Cooper, et al., 2007). Furthermore, caregivers are naturally more likely to respond to infant vocalizations than any other form of infant behavior (Albert et al., 2018; Goldstein & Schwade, 2008; Gros-Louis & Miller, 2018; Gros-Louis, West, & King, 2016; Pretzer et al., 2019). Caregivers and infants alike will have frequent opportunities to experience the contingency. Because infants under 12-months-old are more likely to engage in immature vocalizations (vowel-like sounds) than mature vocalizations (consonant-vowel sounds), training caregivers to imitate both mature and immature vocalizations will provide more learning opportunities for caregiver and infant.

A vocal imitation contingency-learning game may be an optimal contingency-learning game because the caregiver is likely to acquire the skill and contact reinforcement, and also likely to maintain and generalize performance. For one, vocal imitation is an easy response for a caregiver to engage in immediately and repeatedly. Furthermore, an infant is likely to follow vocal imitation, which may reinforce the

caregiver's imitative behavior (Field, 1977). Therefore, teaching caregivers to engage in vocal imitation is a target response that is likely to be maintained and generalized to new environments due to the likelihood that the caregiver will: a) engage in the target response in novel contexts, and b) contact reinforcement immediately after engaging in the response. Teaching caregivers to imitate their infant's vocalizations is likely to result in benefits for both the infant and caregiver, and result in behavior change that will maintain and generalize in the natural environment.

While it may not be critical for all families to access training to promote contingency learning, contingency-learning games will only enhance an infant's ability to detect the contingencies in their environment and will likely also produce positive collateral effects on behavior. The primary benefit of targeting all families and infants at a population-level is that there is a greater likelihood that families who need training will access the training.

Caregiver Training

Common Components in Evidence-Based Training

Caregiver implemented evidence-based interventions are effective and socially and ecologically valid approaches to support healthy infant and child development (Kaminski, Valle, Filene, & Boyle, 2008). Caregiver training is an effective approach because caregiver behavior mediates child outcomes. Kaminksi et al. (2008) conducted a meta-analysis of caregiver training programs that targeted parent skill acquisition. The authors coded for components of caregiver training: (a) targets for skill acquisition, (b) instruction on child development, (c) inclusion of a standardized manual, (d) opportunities to practice the skill with their child and facilitator feedback, (d) emotional

interactions, (e) how to consistently discipline for bad behavior. The three target responses associated with the most improvement in parent behavior were: (a) positive interactions as the target response (i.e., learning skills that promote positive parent-child interactions, (b) emotional communication (i.e., active listening, teaching children to connect emotions and words associated with emotions), (c) discipline management (i.e., consistently communicating contingencies of behavior, and delivering consequences for unwanted behavior). The training activity associated with the best outcomes was that the parents were required to practice the target skills with their child, in the presence of a facilitator who provided feedback on their performance.

Trainings that targeted parent knowledge of child development effectively taught parents facts about child development; however, parent improvement on target behaviors were only detected if the child knowledge components were paired with opportunities to directly apply the concepts during practice with their child (Kaminski et al., 2008). The meta-analysis identified components of training that are similar to components identified in other reviews of effective skill-based training (Joyce & Showers, 2003; Lundahl, Risser, & Lovejoy, 2006; Parsons, Rollyson, & Reid, 2012). Parsons, Rollyson, and Reid (2012) for example, identified four essential components of effective behavior skills training: (a) descriptions and rationale for using target skills, (b) model via video or live modeling, (c) mother practice of the skill, (d) live in-person, bug-in-ear, or distance coaching and feedback.

Essential components of caregiver training are similar to the methods to teach discriminated responding described earlier. The literature indicates the CCB supports infant development by helping the infant discriminate the effect of their own behavior on

the environment. Kaminsky et al. (2008) also found that giving parents an opportunity to practice the skill with their child while a facilitator provided feedback was also a critical component. The practice with feedback component is discrimination training for the parent. The facilitator provides contingent feedback and support based on the parent's performance. Including instruction on child development that is directly linked to the target response of the training may enhance the outcomes of caregiver training. Child development instruction may support antecedent discrimination, where parents may be more able to identify relevant variables in the environment (Ferjan Ramírez et al., 2019; Joyce & Showers, 2003; Parsons et al., 2012).

Training Caregivers

Mothers have been trained to engage in CCBs including vocal imitation (Ferjan Ramírez et al., 2019; Goldstein, Schwade, & Bornstein, 2009; Pelaez et al., 2018, 2011) labeling, and praising (Bagner et al., 2016; Bagner, Rodríguez, Blake, & Rosa-Olivares, 2013; Ferjan Ramírez et al., 2019; Garcia et al., 2015; Kohlhoff & Morgan, 2014; Landry, Smith, & Swank, 2006). In a randomized controlled trial, Ferjan Ramírez, Lytle, Fish, and Kuhl (2019) evaluated a caregiver training that taught parents responsive techniques (e.g., infant-directed speech, parentese) to use with their infants during two training sessions, lasting on average two hours. Parents recorded interactions in the home-language environment when their infant was 6-, 10-, and 14-months. Following six- and 10-month recording periods, trainers coached parents in how to engage in responsive parenting strategies in a clinic setting, using didactic instruction. Trainers then played a clip of a parent-infant interaction with the participant's infant. The parent identified which responsive technique they used in the clip, and trainers expanded and

provided feedback. Parents who received training engaged in more CCB with their infants compared with parents in the control group.

Training caregivers to engage in responsive parenting is an evidence-based and socially-valid approach for improving child development outcomes (Roberts & Kaiser, 2011). Adamson, Kaiser, Tamis-LeMonda, Owen and Dimitrova (2019) suggest that caregiver training that targets CCB should begin prior to the age when children begin to speak their first words (around 12 months).The authors suggest that the production of first words is the result of an extensive skill building process across many pre-requisite skills (e.g., joint attention, canonical babbling, imitation); therefore training caregivers early to provide supportive environments is important. Preventative caregiver training entails the need for broad dissemination methods. While the extant literature on caregiver training suggests it is possible to train parents to engage in more CCB, less is understood how to scale-up caregiver trainings so that may be delivered to more families. Training caregivers to use CCB at a population-level may be possible, but challenging, due to barriers associated with dissemination of evidence-based programming (Darcy Mahoney, McConnell, Larson, Becklenberg, & Stapel-Wax, 2019).

Barrier to Accessing Caregiver Training

Barriers associated with population-level dissemination of caregiver training prevent some individuals who would benefit from gaining access to training (Darcy Mahoney et al., 2019). Some barriers to population-level dissemination of evidence-based caregiver training are related to human resource variables (i.e., insufficient professionals with training; insufficient funds to pay professionals; inability for participants to travel to training). One strategy to mitigate barriers is to deliver training

asynchronously, reducing the need for a trained professional to deliver the training. The challenge in eliminating the trained professional, however, is that the trained professionals are essential for producing optimal outcomes *because* the professionals have the expertise to provide behavior-based feedback and coaching on participant performance. Thus, a training methodology that is able to reduce the role of a professional may be a promising approach for achieving population-level dissemination. Computer-based training technologies, such as interactive computer training (ICT) have expanded access to evidence-based training and intervention (Corralejo & Domenech Rodríguez, 2018; Gerencser, Akers, Becerra, Higbee, & Sellers, 2019).

Caregiver Training using Technology

Interactive computer training. ICT are computer-based trainings that require participant participation in interactive activities. ICTs typically include interactive micro-units with brief video lectures or tutorials. Computer-training design literature suggests that the most significant component of asynchronous learning that relates to learner engagement is the length of instructional videos (Dunst, Raab, Embler, & Roberts, 2018; Kim et al., 2014). Specifically, instructional segments lasting fewer than three minutes were associated with the most participant engagement. Microlearning units are also associated with effective computer-based instruction. Microlearning units support the learner's mastery of a few skills or behaviors, rather than mastery of many skills or behaviors (Dunst et al., 2018). Caregiver training focusing on a few key target behaviors is more effective than training targeting multiple behaviors which may be because participants are more able to discriminate the target behaviors and how they are related to changes in the environment (Kaminski et al., 2008).

ICTs and other technology-based trainings have been used in research to teach caregivers a variety of skills including behavior-based parenting, and parent-child interactive approach to support adaptive behavior (Corralejo & Domenech Rodríguez, 2018). Corralejo and Domenech Rodríguez (2018) found that while the use of technology-based training is increasing, individuals from ethnic or language minority groups continue to have fewer opportunities to access training. ICTs often incorporate the critical components (e.g., instruction, modeling, rehearsal, feedback) of evidence-based training described by Parsons, Rollyson and Reid (2012; see Gerencser, Akers, Becerra, Higbee, & Sellers (2019) for a review of asynchronous computer-based trainings . ICTs can deliver information via presentation videos with voice-over narration and embedded opportunities to interact. ICTs can also incorporate modeling using video examples, with or without voice-over narration. ICTs can prompt the learner to engage in rehearsal (i.e.,practicing engaging in the target response). In addition to components traditionally included in caregiver trainings (e.g., didactic content, modeling), ICTs also include learning components that require the learner to engage in a response, rather than only watch or listen to training content. For example Gerencser, Higbee, Akers, & Contreras (2017) included a rehearsal component (e.g.,caregivers were required to practice engaging in each of the target responses) in a study that aimed to train caregivers to use picture-based activity schedules with their child with autism spectrum disorder.

Active engagement is an essential component of ICT as evidence from face-to-face caregiver training studies suggest that trainings that require the parent to engage in the target skill during training are more effective than trainings that do not (Kaminski et al., 2008). It is more difficult however, to provide individualized feedback to the learner

on their performance of the target response. Component analyses of in vivo training packages have found that feedback may be the most critical component of a training package which may explain why ICTs are only effective for some learners and for some target behaviors (Vismara et al., 2018; Vismara, McCormick, Young, Nadhan, & Monlux, 2013; Wainer & Ingersoll, 2013).

Self-directed ICTs for parents typically require some form of direct feedback or contact with a professional. In some caregiver trainings, participants who did not achieve mastery criteria received live-coaching sessions before meeting mastery criteria (Nefdt, Koegel, Singer, & Gerber, 2010; Wainer & Ingersoll, 2015). One of the hypothesized advantages of on-line self-directed training, such as ICT, is that a caregiver could complete the training without direct support or coaching from a trained professional. The extant literature suggests that additional training development and research is needed to identify computer-based training methodology that is consistently more effective when coaching and feedback is not included.

There is evidence to suggest that training individuals to evaluate performance of others engaging in a target skill has a causal effect on the evaluator's subsequent performance of the same skill. The observed change in the evaluator's performance is called the observer effect (Alvero & Austin, 2004). Incorporating observer effect methodology within an ICT may be an effective approach for teaching caregivers to play a contingency-learning game with their infant. If effective, it may be possible to disseminate a contingency-learning game ICT on a population-level.

CHAPTER II

LITERATURE REVIEW

Search Process and Results

We completed a literature review to identify the use of observer effect training. We completed a search using combinations of the following search terms: *observer effect, training development "professional development, skill acquisition, caregiver or parent training, self-monitoring, behavioral safety* in Academic Search Ultimate, CINAHL Complete; Education Full Text (H.W. Wilson); Education Source; ERIC; Health Source – Consumer Edition; MEDLINE; Professional Development Collection; Psychology and Behavioral Sciences Collection; PsycINFO The initial search yielded 601 results. We limited search results to journal articles and dissertations, which resulted in 581. After removing any duplicates, 430 articles remained. In order to be included for review, papers must have met the following criteria: (a) participants were over 18-years-old and not have a reported disability, (b) the experimental design isolated the effect of observing and taking data on procedural adherence on the participant's subsequent performance of the observed behavior, (c) be published in English. We also consulted with researchers involved in many of the identified studies to ensure that all relevant articles were identified. In total, 15 articles met inclusion criteria. See Table 1 for a summary of observer effect studies.

Initial Studies

Alvero and Austin (2004) evaluated the effect of conducting safe behavior observations and evaluations on the observer's subsequent performance engaging in safe behavior. The impetus for the study can be traced back to research in the organizational

safety literature and one commonly implemented process, behavioral-based safety (BBS). BBS is a systems level process for establishing and maintaining safe working behavior in work settings where there is a high-risk for injury due to accidents or repetitive motion activities. BBS follows a functional approach that encompasses steps also employed in functional behavior assessments for problem behavior. That is, organizations first (a) assess the work environment to identify behavior associated with low incidence of injury, (b) operationally define desirable behaviors so that the behaviors may be reliably measured overtime, (c) conduct regular performance evaluations that include immediate delivery of performance feedback (e.g., tell the performer of correct and incorrect instances of the target response, and provide additional teaching, or modeling a correct response, if needed), (d) systematically reinforce correct adherence to behavior targets (Sulzer-Azaroff & Austin, 2000). Peer safety observations, where workers monitor each other's behavior and provide immediate feedback on performance is a common component of BBS. The purpose for including peer performance evaluation was to reduce the need for managerial staff's involvement, while continuing meeting other program goals (i.e., frequent collection of safe behavior performance and delivery of reinforcement for meeting performance goals), thus protecting supervisor hours for other management related job responsibilities (i.e., a cost-saving measure). Given that the workers tasked with measuring performance of others were also responsible and expected to complete the same job tasks, Alvero and Austin (2004) hypothesized that the process of completing performance evaluations may have a measurable effect on the subsequent behavior of the performance evaluator.

Alvero and Austin (2004) evaluated safe-work postures of college students in a simulated office setting. Researchers measured safe work behaviors and reported as the percent of intervals that included safe posture for eight types of safe work behavior (e.g., neck alignment, safe lifting). The investigators split participants into Group A and Group B and evaluated intervention effects across a multiple baseline design across behaviors. During baseline, all participants in both groups were given instructions to complete tasks while working at a computer in a simulated office environment. During the information phase, Group A received a sheet with operational definitions for half of the target behaviors. Group B received an information sheet for the remaining target behaviors. For all opportunities to show an effect of the information phase on performance (four behaviors across 8 participants), an effect was only apparent in 22% of opportunities. During the observation and evaluation phase, prior to each session, participants watched a 5 min video of a confederate engaging in a simulated office identical to target responses. Participant performance improved following the observation and evaluation phase, but only for behaviors that they evaluated during pre-session observation. All participants performance improved immediately after the observation and evaluation phase began, indicating that the process of scoring videos for accurate performance was functionally related to all participant's subsequent performance. The findings from Alvero and Austin (2004) suggest that a brief video evaluation activity may be an effective training methodology. Alvero and Austin where unable to determine the mechanisms of change responsible for the change but named the change in behavior as an "observer effect".

Table 1
Observer effect studies

Study	*n*	Participants setting	Measures	Training methods
Behavioral safety studies				
Alvero & Austin (2004)	8	college students; university lab	% MTS safe office behaviors	(a) information and hand-out; (b) scoring checklist watching video
Sasson & Austin (2005)	11	hospital office workers; hospital accounting and scheduling office	% MTS safe ergonomic positions	(a) in-vivo training, hand-out, modeling, rehearsal; (b) training to score behavior of others; in-vivo observation of confederate
Alvero & Austin (2006)	11	college students; university lab	% MTS safe posture	(a) no training on safe posture; (b) scoring checklist of safe posture
Alvero et al. (2008)	6	college students; university lab	% MTS of safe posture	(a) in-vivo information, handout w/definitions of target behaviors; observation of video using checklist
Robek (2008) **dissertation*	8	college students; university lab	% MTS safe posture	(a) in-vivo information, handout; (b) video, whole-interval data collection
Taylor & Alvero (2012)	5	college students; simulated office environment	% MTS safe posture; accuracy	(a) discrimination computer training with instruction, model, practice; (b) observation and scoring videos
King et al. (2018)	6	college students; university lab	% MTS of safe posture; accuracy	(a) in vivo training, handout, PowerPoint training; (b) score videos of others safe postures, in-vivo training how to collect data
Caregivers as implementers				
Guercio & Dixon (2010)	15	residents in a neurobehavioral treatment center	% positive interactive behaviors	(a) in-vivo task clarification on target responses; (b) observation of video using checklist and observation form
Nielsen et al. (2009)	6	nursing staff, patients who needed assistance standing; acute care hospital	% safe lifting behavior from wheel-chair to stand position	(a) in-vivo training of safe lifting; (b) video-scoring with checklist; (c) graphical performance feedback
Williams & Gallinat (2011)	4	college students; day treatment center for individuals with intellectual disabilities	% DTT components	(a) in-vivo training on using checklists, modeling and instruction for DTT, (b) video observation and checklist scoring of self; (c) video observation and checklist of others
Thomas (2013)	3	public-school paraprofessionals, school	% correctly implemented components of DTT	(a) handout with operational definitions of DTT components; (b) in-vivo training of how to score checklist, in-vivo observation of peer
Howard et al. (2013)	5	supervisors at day treatment center	frequency of behavior specific praise	(a) no initial training; (b) in-vivo data collection using checklist

Field et al. (2015)	20	graduate psychology students; university lab	% correct functional analysis implementation steps	(a) in-vivo information and written protocol review; (b) scoring videos using checklist
Rosales (2018)	4	college students; university lab	% correct use of picture exchange communication system	(a) handout; (b) video-based training, operational definitions; printed handout; coding videos
Marroquin et al. (2014)	3	mothers and child with autism; home	least to most prompting procedures; # caregiver prompts; % child compliance	(a) in-vivo, handout, (b) observation of videos, plus in vivo trainer talk-aloud

Note. MTS = momentary time sample; DTT = discrete trial training

Observer effect, reactivity, and observational learning. Before describing subsequent studies, we will review a few important terms that may help discriminate what the observer effect is, and what it is not. This is important because the observer effect is related to, but not equivalent to other common behavioral phenomena (i.e., reactivity & observational learning). The observer effect is defined by a change in an individual's behavior that occurs following the individual observing and evaluating the performance of another individual engaging in the same target behaviors. Observational learning is thought to occur when the process of observing another individual's behavior, in addition to observing the consequence that follows (effective or ineffective), allows the observer to behave correctly. The exact explanation for observational learning includes multiple possible controlling variables. For example, if the observed consequence is desired, the observation of the behavior-consequence contingency may function as a discriminative stimulus, signaling that the observer's subsequent behavior may result in a preferred consequence. Evidence-based training programs typically include an observational learning component (e.g., video model, live model, naturalistic

observations). A distinguishing feature of the observer effect is that the learner not only observes a behavior, the learner also engages in evaluation of the behavior, discriminating the occurrence or non-occurrence of a behavior. Results from Alvero and Austin (2004) demonstrated that performance only improved when observation and evaluation occurred. When participants observed, but did not score performance, subsequent behavior was unchanged.

Reactivity is another behavioral term that may be confused with observer effect and is defined as the observed and systematic change in an individual's behavior that is functionally related to the presence of an observer. Simply stated, the effect of an observer on performance, or, an observer effect. While reactivity and the observer effect may be different, they may also be functionally related. That is, the presence of an observer may result in systematic changes in performance of the observed performer in observer effect arrangements (King, Gravina, & Sleiman, 2018). Reactivity and observer effect in staff performance outcomes may be beneficial. Paraprofessionals in special education classrooms, for example, are often tasked with carrying out multi-component individualized interventions with students. If a school system used a behavior-based safety approach, paraprofessionals would collect performance data on each other. There is evidence that the treatment fidelity activity will result in improvement in both the evaluator's performance, and the performer's performance. The mere presence of an observer may or may not result in reactivity. The knowledge that one's own performance is being evaluated may make it more likely that reactivity occurs (King et al., 2018; Sasson, Alvero, & Austin, 2006; Taylor & Alvero, 2012). Findings from King, et al. (2018) suggest that training outcomes may be improved if the trainee is also aware that

their own subsequent performance of the skill will be measured (Howard, Burke, & Allen, 2013). To summarize, the observer effect is not describing observational learning, although observational learning may be functionally related to some changes in performance following training. Nor is the observer effect describing reactivity, although reactivity may be functionally related to the likelihood that an observer effect will be observed. Instead, observer effect describes the change in an individual's behavior, where the observation *and* evaluation of a target response results in a subsequent change in the individual's subsequent exhibition of the response. We will refer to training components that are designed to produce the observer effect (i.e., the study includes instruction, observation, and evaluation) as an observer effect activity (OEA).

Observer Effect with Caregivers

Five studies provided training to direct care providers of individuals with disabilities, including parents (Marroquin et al., 2014) and staff (Field et al., 2015; Howard et al., 2013a; Thomas, 2013; Williams & Gallinat, 2011). Field et al. (2015) trained 19 graduate students to complete traditional functional analysis conditions (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). A functional analysis is a series of systematically implemented conditions to identify the function of problem behavior. Each condition entails a specific set of implementer behavior that either should, or should not occur, depending on the behavior of the client. For example, to test for an escape function (behavior that occurs to access removal of a stimulus), the implementer must present demands to the client, and only remove the demands when the client exhibits the specific target response. In Field et al. (2015), training included an information phase, an OEA phase and an additional OEA phase that included evaluation of the participant's own

performance. Out of 19 participants, four participants met mastery criteria for all conditions during the information phase, thus not requiring the observer evaluation phase. Nine participants met criteria following the OEA phase. The remaining seven participants met criteria after completing observer evaluations of others engaging in the target behavior, in addition to evaluating performance of their own behavior. The results suggest that OEA is effective even though the target skills were complex. Only nine participants out of 14 met criteria following the OEA without additional support. Alvero and Austin (2004) speculated that training complex skills may require additional training supports. In contrast to past studies where participants did not meet mastery following OEA (e.g., Alvero & Austin, 2004), for Field et al. (2015), 19 of 20 participants achieved mastery without requiring direct professional involvement.

Caregivers of Young Children as Implementers

Marroquin, Alvero, and Sturmey (2014) employed OEA to train three mothers how to implement graduated compliance training while interacting with their child with autism spectrum disorder. The study included a baseline, observation, and one dyad also received feedback. Baseline with instruction only consisted of the instructor reading an instruction sheet while the parent followed along. The instructor then prompted the parent to give the child an instruction to complete a chore. Each session included five opportunities to direct the child to complete a chore. Behavioral-observation phase consisted of the parent watching a video of another parent engaging in the same compliance procedure. As the parent observed the video, they scored a checklist with correct, or incorrect use of each skill. If the observed parent did not meet mastery criteria during test trials with their child, (90% correct use of components across two consecutive

sessions), the researcher provided immediate feedback on the scoring checklist. Feedback included both corrective and supportive feedback. Results indicated that two parents were able to reach mastery following the observation phase, while one parent required feedback to achieve mastery.

Results from Marroquin et al. (2014) are similar to those found in other studies using OEA, in that some participants were able to meet mastery, while others were not. The majority of studies thus far examine relatively simple target responses (e.g., Alvero & Austin, 2004; Myers, McSween, Medina, Rost, & Alvero, 2010; Taylor & Alvero, 2012; Thomas, 2013). Whereas Marroquin et al. (2014) and Field et al. (2015) taught a complex target response. Conducting a functional analysis of problem behavior and implementing compliance training requires the learner to engage in multiple behaviors in a specific order, and dependent on the child's response, across multiple time points. In both studies teaching complex skills, live coaching and feedback was required for at least one participant in order to achieve mastery. Moreover, all OEA studies thus far required some interactions between participant and professional either during initial training activities, or as additional prompts. If the purpose of using OEA is to reduce cost of training and increase access to training, even when therapists are unavailable, research is warranted to identify OEA training that is effective when delivered without direct involvement during training phases, and only provides direct coaching and feedback when other training strategies fail to produce performance mastery.

Two studies (Nefdt et al., 2010; Wainer & Ingersoll, 2015) included embedded OEAs within technology-based trainings to teach responsive parenting; however, in both studies, the effect of the OEA component was not isolated to test for a functional

relationship between the training target and the activity. Thus, neither study was included in the literature results. The findings from Nefdt et al. (2010) and Wainer and Ingersoll (2015) are relevant given they include OEA and they target CCB skills directly. In a randomized control trial, Nefdt et al. (2010) trained 27 caregivers to use pivotal response treatment (PRT) with their child with autism spectrum disorder using instructional videos and a printed instruction manual. PRT is an evidence-based intervention for children with ASD designed to train implementers to modify learning environments in ways that encourage their children to engage in pivotal behaviors (initiations, motivation to respond). The main features of the approach include (a) identification of naturally occurring motivation, (b) contriving motivation to access through blocking access, (c) delivering the items contingent on a target response. Approximations of the target response are also reinforced to support shaping up more mature requests for items (Steiner, Gengoux, Klin, & Chawarska, 2013). The training included 14 chapters with accompanying quizzes following each chapter. Quiz answers were also present in the printed manual. Following completion of all chapters, parents were instructed to complete a learning task. The learning task consisted of parents watching video examples and scoring examples of the presence or absence of a target response. Following each video sample, a scored data sheet was presented in the video with a narrated explanation of the given score. This was included for cases when the parent's score was incorrect. Parents recorded and submitted a self-recorded 15 min video of the child and parent playing. The first 10 min of each video was coded for parent adherence.

Results indicated that parents in the intervention group made significant gains in target skills as compared with the control group. In addition to change in parent skills,

there was also a significant difference in functional child utterances. Nefdt et al. (2010) did not highlight the learning activity (parent video evaluation component) as the causal ingredient that explained parent behavior change. There were a few notable limitations of the study. First, the study relied on parent for use training materials, meaning it is not possible to know for sure if parents interacted with the videos, how much time they spent interacting with the training, or if all components were completed. Furthermore, there were no generalization or maintenance probes. Parents in the intervention group made significant improvements compared to the control group; however, there was no mention of a mastery criteria for performance. Despite limitations, results from Nefdt et al. (2010) indicate that parents were able to: (a) independently complete all components of a training, (b) improve performance of the target skills, (c) see concomitant changes in child behavior. Future research using similar methodology should include training procedural fidelity measures, include maintenance and generalization probes, and include direct rather than indirect measures of the target behaviors.

Wainer and Ingersoll (2013) used OEA methods and ICT to train three parents of children with autism to use reciprocal imitation training, a training approach that teaches parents to use contingent imitation of their child, and to provide their child reinforcement contingent on the child’s imitation. The ICT training package was similar to the training components in Nefdt et al. (2010) with a few exceptions. The training used an on-line training, not videos. There was a supplementary printed training manual. Results indicated that two parents were able to reach mastery criteria following the training package which included OEA methods. For one parent, a change in level from baseline to

post-training was observed, but performance fell just short of mastery. After live feedback was provided, the parent met mastery.

Summary of Observer Effect

The literature on OEA methodology suggests that it is possible to train without direct feedback for some learners. Whereas this has not been directly tested, a synthesis of the existing evidence and a subjective estimate of complexity of target responses across studies, the complexity of a target skill may differentially predict the efficacy OEA, where the simpler the target skill, the more likely OEA will result in mastery for more individuals. Additional research is needed to identify to what degree and to what extent the complexity of a target response is related to efficacy. Similar to the benefits of ICT, OEA is a training dissemination technology that has the potential to broaden the access to evidence-based training; however, the extant literature suggests that similar to ICT, OEA is only effective with some learners and efficacy may be functionally related to the complexity of the target response. Furthermore, only three studies included parents as the participant receiving OEA (Marroquin et al., 2014; Nefdt et al., 2010; Wainer & Ingersoll, 2013). Moreover, only two studies using OEA have included procedures that did not include direct involvement initially (Nefdt et al., 2010; Wainer & Ingersoll, 2013). Finally, neither Nefdt et al. (2010) nor Wainer and Ingersoll (2013) mention the observer effect. Rather, the video coding activity was included as part of a multi-component training package. Neither study cited research suggesting the activity would be beneficial, nor did they provide any rationale as to why they included the component.

Similar to Nefdt et al. (2010), OEA may be an effective training approach for teaching CCB to parents of young children. Delivering the training as an on-line ICT

technology may mitigate barriers to dissemination. Moreover, as many parents already seek out information via the world wide web (McGoron & Ondersma, 2015), self-directed activities that are evidence-based may be a socially valid means to deliver training. Research that isolates the effect of training mothers to vocally imitate their infant's vocalizations has never been evaluated when vocal imitation is the only target response of the training. Furthermore, OEA methods have never been used with mothers and infants. The proposed intervention may contribute evidence supporting the use of OEA to facilitate training dissemination for mothers and their infants.

Purpose and Research Questions

The purpose of the current study was to evaluate the effect of an ICT with embedded OEAs, instructional videos, and rehearsal activities, on mothers' subsequent use of vocal imitation of their infant. A secondary purpose was to evaluate the social validity of the target response. To measure social validity, we asked naïve observers (speech language pathologists [SLPs]) with experience training caregivers to incorporate responsive strategies, to rate baseline and post-training videos of mother-infant interactions.

1. To what extent will a functional relationship be detected between a mother completing an ICT and the mother's use of vocal imitation of their infant as measured by a change in percentage of opportunities in which the mother engaged in vocal imitation during baseline and post-training?

2. To what extent will speech language pathologists (SLPs) who have experience working with young children identify differences in maternal interaction quality baseline and post-training video examples?

CHAPTER III

METHOD

Participants

Mother-infant dyads. We recruited three mother-infant dyads for participation. Inclusion criteria required mothers to speak English fluently and to speak English to their infant. Infants were: a) full-term delivery, b) at least 1500 grams birth weight, c) no time spent in NICU, d) no diagnoses, e) parent report of infant sitting in high chair for 10 min without problem behavior.

Dyad 1 – Amy and Kirsten. Amy was a White, non-Hispanic 26-year-old woman. She was married and not employed during the study. Her college education consisted of a two-year associate degree. Amy's daughter, Kirsten, was her first and only child. Kirsten was 8-months, 4-days-old at the beginning of the study.

Dyad 2 – Jo and Ryder. Jo was a White, non-Hispanic 25-year-old woman. She was married and not employed during the study. She earned a bachelor's degree in Elementary Education. Ryder was her first and only child. Ryder was 8-months, 9-days-old at the beginning of the study.

Dyad 3 – Claire and Beth. Claire was a White, non-Hispanic 30-year-old woman. She was married and employed part-time during the study. Claire earned her bachelor's degree in Marriage and Family Studies. Beth was her first and only child. Beth was 9-months, 28-days-old at the beginning of the study.

Experimental Procedures

Setting and Materials

Mother-infant interaction sessions. We conducted all sessions in a university-based clinic. We completed test sessions in a room which was approximately 3 m by 5 m and included an adult-sized chair for the mother, and an adjustable high-chair. Each mother brought toys from home that were non-music producing (e.g., rattle, board book, ribbon). The generalization probe occurred in an identical therapy room as the test session, except that in place of a high-chair, infants sat in whatever carrying device in which the mother transported the baby, which for all participants was a stroller. We did not compensate participants for participation in this study.

Maternal training sessions. Each mother completed training sessions in a therapy room that included a table, computer, external monitor, wireless mouse, keyboard, and headphones with a microphone. We recorded each training session using screen capture software for treatment fidelity data collection. We used the online learning management system (Canvas), and a video tagging software (GoReact). All mothers completed training activities in one session lasting less than 45 min.

Materials. Recording equipment in session rooms included: a) a small table, b) lap-top computer, c) web-camera, d) external microphone, e) GoPro camera, f) Zoom meeting, g) clinic room recording system. During the session, the laptop was in sight of participants. We used iMovie to embed beeps during session videos for official data collection. We collected data using: a) data collection sheet, b) headphones, c) video with 10-s beep.

Study design

We used a non-concurrent multiple-baseline design across mother-infant dyads to measure the effect of the ICT on the mother's use of contingent vocal imitation. Study phases included: (a) baseline, (b) post-training, (c) generalization, and (d) maintenance. We included one generalization probe during baseline, post-training, and maintenance. Dyad 1 and Dyad 2 started training in the same week. Dyad 3 started training two-months after Dyad 1 and Dyad 2. Table 2 displays the number of sessions per clinic visit and the days between each clinic visit per dyad.

What Works Clearinghouse guidelines for single-case design suggests that multiple baseline designs should include five data points in both baseline and post-training (Kratochwill et al., 2013). Three data points in baseline may be sufficient to reduce the likelihood of reporting a false-positive result, so long as at least five data points are included in post-training (Lanovaz, Huxley, & Dufour, 2017). Participants should participate only in as few sessions as necessary to achieve experimental control, especially during the baseline phase where participants have yet to be exposed to the intervention (Snodgrass, Chung, Meadan, & Halle, 2018). Therefore, we used a three-data-point minimum criterion for baseline, and a five-data-point minimum criterion for post-training.

Table 2

Session and Clinical Visits

	Visits		Sessions	
	#	*days*	*Phase*	*#*
Dyad 1	1	1	baseline, generalization	4
	2	3	post-training	1
	3	4	post-training, generalization	8
	4	22	maintenance	2
Dyad 2	1	1	baseline, generalization	4
	2	2	baseline	3
	3	3	post-training	2
	4	14	post-training	4
	5	34	maintenance	2
Dyad 3	1	1	baseline	4
	2	10	baseline, generalization	6
	3	13	post-training	1
	4	14	post-training, generalization	5
	5	29	maintenance, generalization	2

Note. Training occurred on underlined days.

Dependent Measures

Primary measure. The primary dependent variable was the percentage of 10-s partial intervals with maternal vocal imitation of their infant's vocalizations. We defined vocal imitation as any instance where the mother made a topographically similar (e.g., similar in consonant and vowel sounds) vocalization within 2 s of the conclusion of their infant's vocalization. Maternal vocal imitation is a restricted operant, meaning it can only occur if another event occurs (i.e., infant vocalization); therefore, we calculated maternal contingent imitation as percentage of opportunities to imitate. We defined an opportunity to imitate as a 10-s interval that included an infant vocalization. We defined an infant vocalization as any infant voice sounds (including cooing and babbling) lasting at least 0.5 s; non-examples included: vegetative and fussing (e.g., vocalization with arched back, crying, belching, hiccupping, sneezing, straining sounds, and whining; based on Pelaez, Borroto, & Carrow, 2018; Pelaez, Virues-Ortega, & Gewirtz, 2011).

To equate opportunities for the mother to engage in vocal imitation across sessions and dyads, we defined a session as including 10, 10-s intervals in which an infant began vocalizing. We decided to include 10 intervals to provide sufficient opportunities to identify patterns and trends in responding, while also allowing for brief sessions, appropriate for infants. During some intervals, infants vocalized multiple times within a single 10-s interval; however, each 10-s interval was considered only one opportunity for mothers to imitation infants' vocalizations. We scored all 10 opportunities (i.e., intervals) to imitate as including maternal imitation or not including maternal imitation. If the infant began vocalizing near the end of a 10-s interval, maternal imitation was counted for the interval in which the infant began vocalizing. If the infant

vocalized three separate times within an interval, and the mother imitated any one (or more) of the three instances, the interval was scored as 1 out of 1 opportunity to imitate. We then divided the number of intervals in which mothers' imitation occurred by the total number of intervals in a session (i.e., 10) to get a percentage of intervals with imitation. See Appendix I for interval scoring examples.

The data collection system meant that all infants engaged in a vocalization at least 10 times each session. The data collection system also ensured that the mother had at least 10 opportunities to imitate. Our data collection system also meant that the length of each session differed. For example, the shortest possible session duration was 100 s, where the infant engaged in a vocalization during each of the first 10 intervals. The longest session was 420 s. We set the mastery criterion for mothers responding to infant vocalizations as two-consecutive sessions at a 60% (or greater) response rate. If the mother performed below 60% for two-consecutive sessions, we would have initiated additional training steps; however, this never occurred.

Secondary measures. We used event recording to measure the frequency of infant vocalizations and maternal imitation during each session. The definition for infant vocalization and maternal imitation is the same as described in the primary dependent measure section. We also measured the duration to complete the computer-based training package.

Baseline and Post-training Procedures

Test sessions allowed us to measure and analyze if the mother's use of vocal imitation occurred more often following training as compared to baseline. Test sessions consisted of the first ten 10-s intervals with infant vocalization. The duration of the

session varied and depended on the time needed to reach 10-imitative opportunities. Mother and child left the clinic room to take a break every 8-10 mins, or earlier if an infant became fussy. If the infant became fussy during a session (as determined by the mother), the session was terminated (see Pelaez et al., 2018). Sessions were only discontinued pre-maturely in one instance for Dyad 1 during post-training, one instance for Dyad 2 during baseline, and never occurred for Dyad 3.

During test sessions the baby sat in a highchair and the mother sat in a chair facing the baby at eye level. Before baseline sessions, the researcher instructed the parent to “Leave your baby in the highchair unless your baby becomes fussy, stay in the chair for the duration of the session.”, and “Interact with your baby as you typically do.” Before the first post-training session, the researcher instructed the participant to “Interact with your baby as you typically do and incorporate the strategies you learned in the training.” Parents had access to all items they brought from home for both baseline and post-training sessions.

Generalization probe. Generalization probes were almost identical to test sessions, including pre-session instructions. Generalization probes occurred in a separate clinic room, and instead of the infant sitting in the highchair, the infant sat in a stroller that the parent brought from home. This probe functioned to identify if the mother engaged in the target response in a familiar context (i.e., stroller brought from home), but one that was slightly different than the training context.

Maintenance probes. We completed two maintenance probes (test probe and generalization probe) during one clinic visit, 14-20 days following the final post-training

session for each participant. Procedures for maintenance sessions were identical to procedures described for post-training and generalization probes.

Caregiver Training

Caregiver training content. We designed the training using a tiered instruction approach, meaning that all mothers would have received a base training package with four learning modules. Mothers would have received additional training only if they did not meet mastery; however, all mothers met mastery criteria with the base training only.

Training procedures. Mothers completed the ICT during a clinic visit while their infant played in an adjacent room. All mothers completed the ICT in one session lasting less than 45 min. The training consisted of four modules: a) Introduction, b) Rehearsal, c) OEA, d) Conclusion. Page one of each module included a general description of the module, a table of activities within the module, and estimated time to complete each component. For a transcript for all training module content, see Appendix A.

Module 1: Introduction. Module 1 included a video with voice-over narration to introduce contingency learning and how contingency learning supports infant development. Video models of maternal imitation were included. The instruction included: (a) definition of responsive parenting, (b) definitions of parentese and imitation, (c) importance of vocal imitation, (d) video examples of vocal imitation.

Module 2: Rehearsal. Module 2 included two rehearsal activities. Participants first watched a video with voice-over narration that described the subsequent rehearsal activities, including specific instructions for the mother to imitate the baby’s babbling in the video. Next, mothers watched a 1 min video of a babbling infant. After completing

the first rehearsal activity, mothers watched and imitated a different babbling baby for 1 min. Following the two rehearsal activities, mothers answered one reflection question (see Appendix B for responses to reflection questions).

Module 3: OEA. Module 3 included two OEAs. Mothers first watched a voice-over narration tutorial that described how to complete the OEA using the video coding software (GoReact). During the tutorial, mothers were instructed to click a button (i.e., red button with white letter ‘V’) each time they heard the mother in the video imitate the infant in the video. Mothers did not mark infant vocalizations. After completing the tutorial, mothers completed two OEAs. Each OEA included two parts. First, mothers collected data on a 1 min video that included a mother-infant interaction. Next, mothers watched a review video of the same mother-infant interaction video that the mother had just scored. The review video included voice-over narration, where the data collector in the video described the choices they made to select or not select an example of imitation (see transcript in Appendix A). The voice-over also included the narrator’s observations from the videos that supported content described in previous sections of the training. For example, in the first OEA video, the baby engages in a growling vocalization, but the mother provides a smooth vocal imitation model. The narrator reiterated an instruction from Module 1 of the training. The narrator also explicitly stated the total number of instances of maternal imitation. The narrator then prompted the participant to evaluate if the participant’s score matched the narrator’s score. Immediately following the review video, each participant completed a second OEA with a new mother-infant interaction and watched a second review video using identical procedures. We did not measure

participant accuracy of data collection. Following completion of the OEAs, mothers completed one reflection question.

Module 4: Course conclusion. Module 4 included a video with voice-over narration that reviewed the course concepts and described the specific imitation game that the mothers were directed to play with their infant during subsequent sessions (see Appendix A).

Additional training modules. None of the mothers engaged in the following training components because all participants met mastery during post-training sessions following the preceding base training described above. If participants *had not* met mastery during the post-training sessions that followed the base training (i.e., two-consecutive sessions below mastery), they would have engaged in additional training components with more intense and direct review components. The additional training components would have included: (a) self-monitoring, (b) asynchronous feedback, (c) feedback delivered via telehealth, and (d) live in-person feedback. All but in-person feedback would have been delivered using a computer. Description of tiered training components are described below.

Self-monitoring. Self-monitoring would have given us the opportunity to determine if completing an OEA by coding one's own performance would have produced mastery of vocal-imitation. Self-monitoring would have been identical to the OEA activity in Module 3, except that the mother would have evaluated the performance of her own interaction with her child, and the mother would not have watched a review video with voice-over narration. They would have watched and coded three video samples (1 min each) of themselves with their infant. Following video coding, they then would have

proceeded to additional post-training sessions. The review video would not have been included in this training component because including a review video would require a professional to provide narration. Thus, the feedback would not be generic, but instead individualized to the participant's performance. We designed the training sequence to allow for independent use, without including individualized feedback components.

Asynchronous feedback. Asynchronous feedback would have included a review video with voice-over narration of the same video samples the mother would have coded in the previous section of training. The video review with voice-over narration would have included specific commentary of correct and incorrect use of maternal imitation. The mother would have watched three review videos (1 min each) and then immediately completed post-training sessions.

Telehealth feedback. Telehealth feedback would have included a meeting with the participant and the researcher over a HIPAA compliant video call software. During the call, the researcher would have reviewed video samples for correct imitation and missed opportunities to imitate. The research would also have facilitated a discussion to identify barriers in participant performance. Post-training sessions would have followed the meeting.

Live in-person feedback. The researcher would have arranged to meet face-to-face with the participant in the clinic. The researcher would have used coaching techniques such as: a) reviewing the target response, b) modeling the target response, c) providing the mother with an opportunity to engage in the target response, d) providing immediate feedback for correct and missed opportunities, e) continuing the cycle until mastery.

Data Collection Procedures

We scored dependent measures from video recordings of participant sessions. To aid in the video scoring process, we overlaid a 10-s beep over session videos. In addition to asynchronous video scoring, a data collector also collected in vivo data. The purpose of in vivo data collection was to estimate when a child had vocalized for 10 intervals. Following each visit, a data collector(s) scored sessions from a video recording. Table 2 describes which day each session occurred.

Procedural and Treatment Fidelity

Interobserver agreement. A second data collector independently scored videos on the primary dependent variable for at least 30% of sessions, across all phases and participants to measure interobserver agreement (IOA; see Table 3). We calculated interobserver agreement using point-by-point agreement, where all agreements per interval were divided by the sum of all agreements plus disagreements, then multiplied by 100 to get a percent agreement (Appendix H).

Table 3

Interobserver Agreement

Participant Dyads	% Collected	Mean IOA %	IOA Range %
Amy & Kirsten	57	92	82-97
Jo & Ryder	53	88	75-96
Claire & Beth	44	86	70-96

Procedural fidelity. An independent observer scored a procedural checklist to measure procedural fidelity (i.e., the degree to which each session was implemented as described) for 49% of sessions across all conditions for each participant and was 100%

for all participants (Appendix F). The data collector calculated the percentage of correct implementation by dividing correct implementation components by the total number of components, and then converted to percent.

Treatment fidelity. An independent observer collected data to measure treatment fidelity (i.e., degree to which the participant completed training activities). The data collector watched the mother complete the training (either in vivo or via a video recording of the training session) and marked each training component as complete or incomplete (Appendix G). The data collector then calculated treatment fidelity by dividing the number of completed training components by total training components and converting to a percent. We evaluated treatment fidelity for all training sessions. All mothers completed 100% of training activities.

Data Analysis

We analyzed the effect of the independent variable (ICT) on the dependent variable (maternal vocal imitation) through visual inspection of percentage of intervals that included vocal imitation in a line graph. Because we used a non-concurrent design, our decisions for when to move from the baseline phase to the intervention was dependent on each mother's performance, and not in response to performance across dyads as would typically be done in concurrent multiple-baseline designs. Each participant remained in baseline until performance was stable (no trend) and at least three data points were collected beyond the previous Dyad. For example, Dyad 1 completed only three baseline sessions, Dyad 2 completed six baseline sessions, and Dyad 3 completed nine baseline sessions. Each participant completed the ICT following baseline.

After the ICT, participants completed post-training sessions. To determine whether or not a functional relationship existed between maternal vocal imitation and completion of the ICT, we looked for changes in level, trend, and variability before the ICT and after the ICT.

Social Validity

We evaluated the social validity of the study process, study procedures, and study outcomes (see Snodgrass et al. 2018) for a review of social validity procedures in single-case designs). We collected social validity by directly asking mothers about their experience participating in the study through embedded survey questions within the ICT, and through a post-training questionnaire. Last, speech language pathologists (SLPs) viewed baseline and post-training video pairs, and answered questions related to the quality of mother-infant interactions.

Video Viewer Participants

Three video viewers naïve to study procedures, observed and evaluated a sample of pre-training and post-training video pairs for each mother-infant dyad. All video viewers were female SLPs who have worked with parents and children under 3-years-old for their entire career as an SLP (*M* = 6.5 years).

Video View Procedures

During SLP sessions, SLPs independently watched a pair of videos, one video for each mother-infant dyad. Each video pair included a 2 min sample from baseline and a 2 min sample from post-training session. We counter-balanced the presentation order of baseline or post-training in the video pair. To reduce the potential for video selection bias

we followed a pre-determined selection process to create video samples. We included the third baseline session for each dyad, to equate the amount of exposure in the clinic across participants. Post-training sessions were taken from the third session following training.

Prior to watching video clips, SLPs were aware that we were evaluating a training that aimed to teach responsive techniques to use with infants but were naïve to specific study methods. For example, SLPs were not aware of the specific target response, the methods to teach the response, nor the condition assignment for each video clip (i.e., we did not tell them if a video was from baseline or post-training). Following each video pair, the observer answered the question “Which video clip (e.g., clip 1 or clip 2) was the best example of responsive parenting?”. We also prompted the participant to provide additional observations from either clip related to the mother-infant interaction. See Appendix D for the specific instructions and purpose that we gave to SLPs. SLPs watched videos independently on their own computer and responded to questions using an online survey. SLPs were able to pause, rewind and replay video clips. We did not observe or take data on participant behavior during video viewing and there were no time limits for completing the survey.

Maternal social validity measures

We measured mothers’ perceived social validity of the intervention process during the caregiver training. Specifically, following the rehearsal activity, OEA, and following the training, mothers responded to questions related to the preceding activity. Mothers completed questions embedded within the ICT. See Appendix B for a list of questions and responses.

We also measured social validity of the process (i.e., activities that the mother completed during study participation) by surveying mothers using a post-study computer survey. Mothers completed the survey immediately following their final maintenance session. The survey was open in a web browser on a clinic computer. Survey responses were not anonymous. See Appendix C for a list of questions and responses.

CHAPTER IV

RESULTS

Maternal-Infant Interactions

Figure 6 depicts the results for maternal vocal imitation as measured by the percentage of 10 infant vocalization intervals that maternal vocal imitation occurred within 2 s of the infant's vocalization. Amy's data are presented in the upper panel of Figure 6. During baseline, Amy's percentage of vocal imitation was stable and low (≤ 20%). Imitation was also low during the baseline generalization probe (10%). Following training, Amy's percentage of imitation immediately increased (90%) during the first post-training session. Amy's responding showed a decrease in level during sessions four and five; however, responding was at mastery criterion (60%). Following session five, imitation increased to 100%. Amy's vocal imitation maintained responding above mastery criterion during both maintenance probes.

Jo's data are also presented in Figure 6 in the middle panel. During baseline, the percentage in which Jo imitated was stable and low across baseline sessions (≤10%). Jo imitated below mastery criterion during the baseline generalization probe (10%). During post-training sessions, Jo's percentage imitation immediately increased to 90%, and reached 100% imitation across opportunities by the fourth post-training session. During the post-training generalization probe, Jo imitated during 100% of opportunities. During the maintenance probe, percentage imitation was above the mastery criterion (60%) but decreased in level to 70%. During the maintenance generalization probe, Jo imitated 90%.

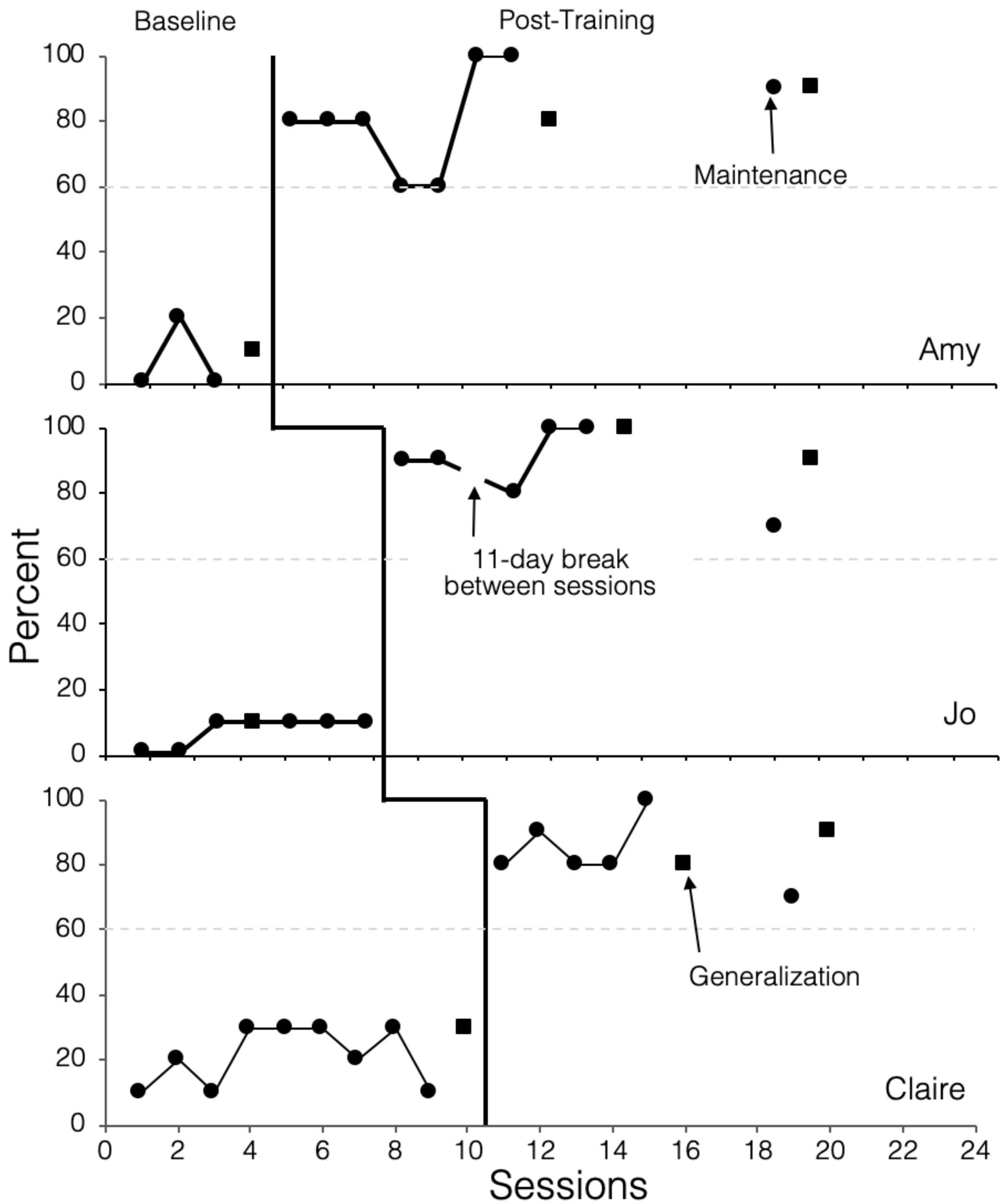

Figure 6. Maternal vocal imitation. The break between post-training session 2 and 3 represents an 11-day gap between Jo's sessions.

Claire's data are also presented in Figure 6 in the bottom panel. During baseline, the percentage in which Claire imitated was stable and low (≤30%). Claire imitated below mastery criterion during the baseline generalization probe (30%). During post-training sessions, Claire's percentage imitation immediately increased to 80%, and increased to 100% in the fifth post-training session. During the post-training generalization probe, Claire imitated during 80% opportunities. During the maintenance probe, Claire imitated above the mastery criteria, but decreased from the preceding post-training session (100%) to 70%. During the generalization maintenance probe, Claire imitated 90% of opportunities.

Infant Vocalization and Maternal Imitation Frequency

The frequency of infant vocalizations and maternal imitation of child vocalizations per session are depicted in Figure 7. Kirsten's vocalizations and Amy's vocal imitation are depicted in the top panel of Figure 7. During baseline, Kirsten engaged in an average of 12.7 vocalizations (12 to 13) per session. During post-training, Kirsten engaged in an average of 13.8 (10 to 18). Ryder's vocalizations and Jo's vocal imitation are depicted in the middle panels of Figure 7. During baseline, Ryder engaged in an average of 12.7 vocalizations (12 to 14) vocalizations per session. During post-training, Ryder engaged in an average of 15.8 (14 to 18). Beth's vocalizations and Claire's vocal imitation are depicted in the bottom panels of Figure 7. During baseline, Beth engaged in an average of 13.4 vocalizations (11 to 16) vocalizations per session. During post-training, Beth engaged in an average of 14.2 (12 to 18). During baseline, there is a separation in data paths between each mother and infant dyad. Immediately

following training, maternal imitation was closer to the frequency of infant vocalizations compared with the frequency maternal imitation and infant vocalizations during baseline.

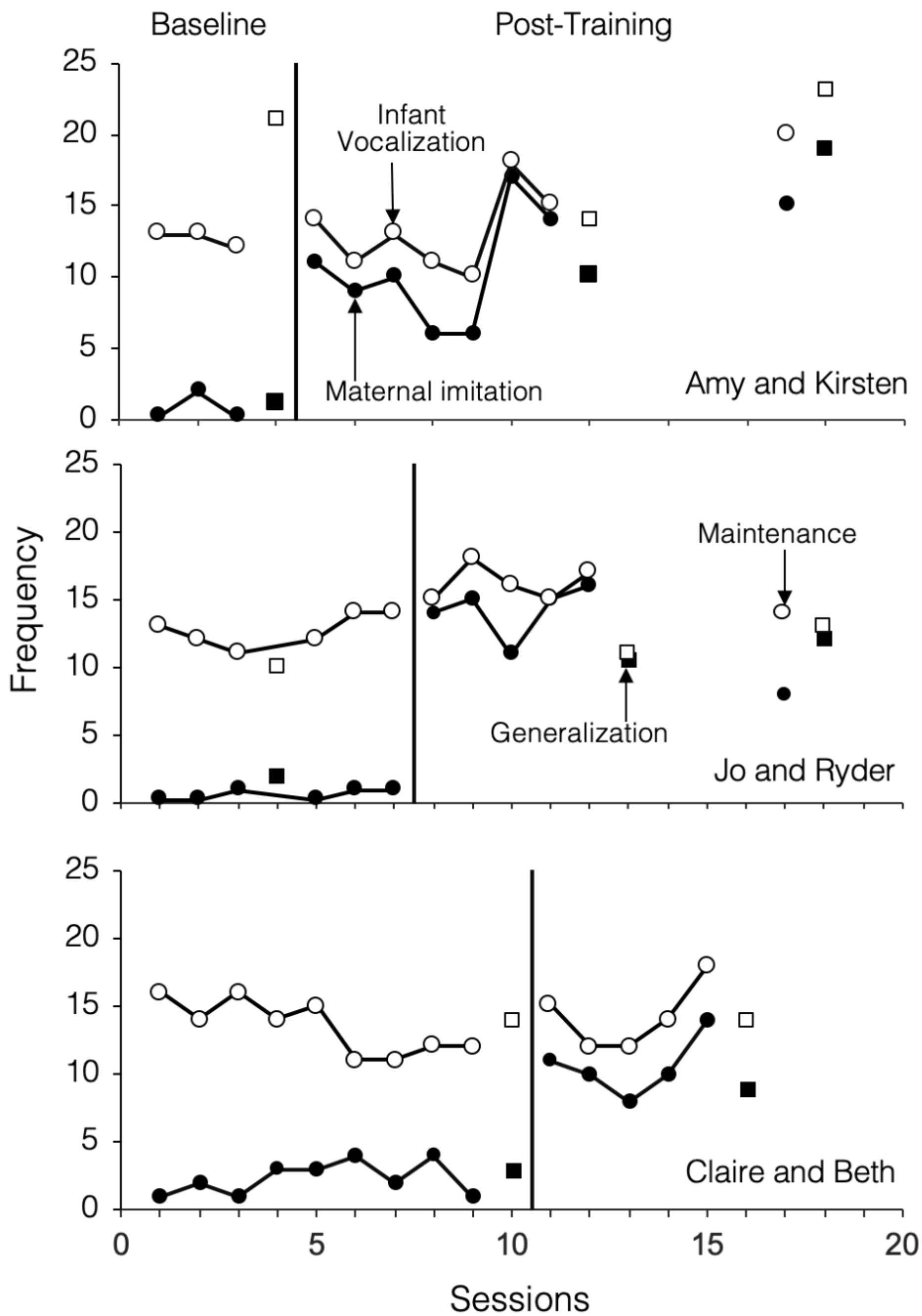

Figure 7. Frequency of infant vocalization and maternal imitation.

Session Duration

Session duration varied across participants. The minimum session length possible was 100 s (i.e., 10 intervals of 10 s each). The longest session was 400 s. Figure 8 depicts the session length across participants. The minimum session length for Dyad 1 was 120 s and the maximum was 310 s (*M* =195.3 s). The minimum session length for Dyad 2 was 100 s and the maximum was 400 s (*M* =197.3 s). The minimum session length for Dyad 3 was 120 s and the maximum was 310 s (*M* =188.3 s)

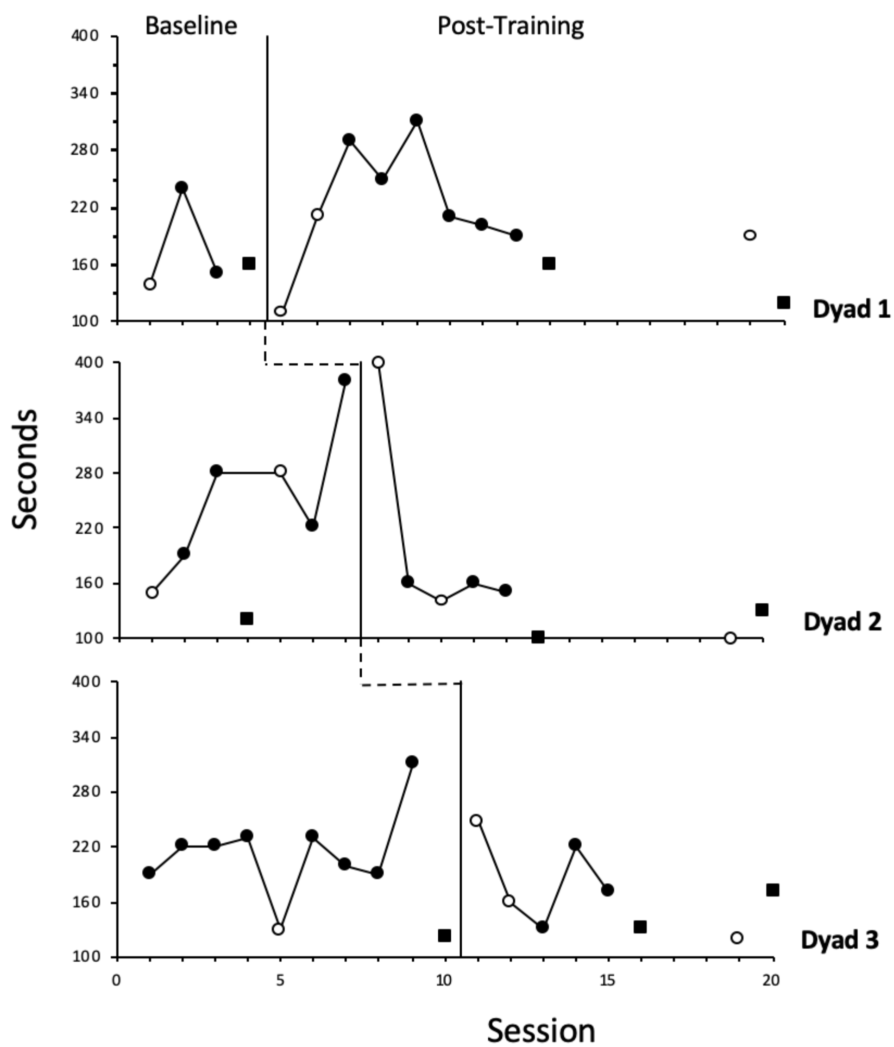

Figure 8. Session duration. The figure depicts the session length. Open symbols indicate the first session for each clinic visit. The y-axis minimum reflects the minimum possible session length.

Social Validity

SLPs. SLP ratings are found in Figure 9. SLPs rated baseline video interactions as superior in 33% of video pairings. SLPs rated post-training video interactions as superior in 66% of video pairings. Two SLPs rated Amy's baseline interaction as superior. Two SLPs rated Jo's post-training interaction as superior. All SLPs rated Claire's post-training interaction as superior. See Appendix E for all SLP comments.

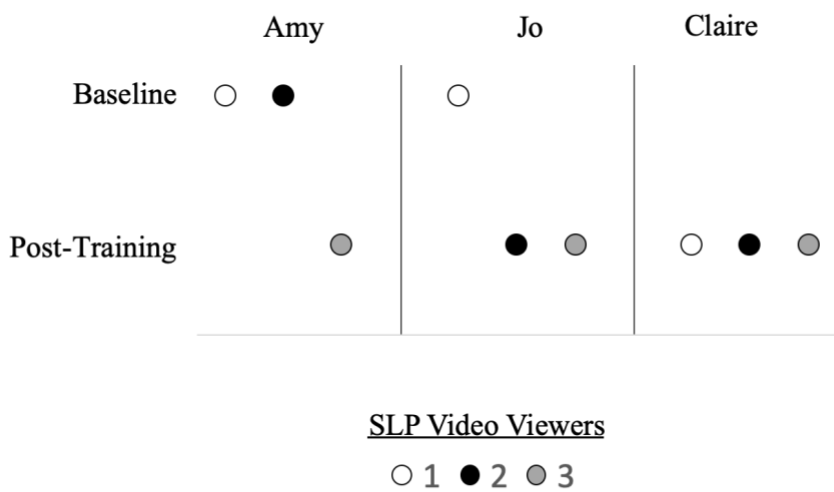

Figure 9. SLP Video viewer ratings. Symbols indicate the SLP selection for the better example of responsive parenting during the mother-infant interaction.

Maternal social validity. Maternal responses to embedded and post-study questions related to the acceptability of the training. All mothers agreed that the training was acceptable and something they would recommend to others. We asked participants which components of the training were most helpful by asking mothers to rank each component. Each mother identified a different component as most helpful. Jo ranked the

information component as the most helpful, while Amy and Claire ranked information as the least helpful. For a full list of responses, see Appendix C.

Training duration. Mothers completed the ICT in under 45 min. Both Amy and Jo completed training components in 36 min. Claire completed training components in 44 min.

CHAPTER V

DISCUSSION

Computer-based training, including ICTs, expands access to evidence-based training and may result in reduced cost and time for providers who train others as part of their job. Training research suggests that training without coaching and feedback, including ICT, is effective for only some participants (Joyce & Showers, 2003). One challenge for trainers designing ICTs is identifying strategies for embedding coaching and feedback within trainings designed to be delivered asynchronously and completed independently by the learner. Embedding activities that require evaluation of others' behavior within ICTs may be an effective alternative to coaching and feedback. This study indicated that mothers who performed below mastery criteria for vocal imitation at baseline, immediately increased performance to meet mastery criteria following the training that included an OEA activity. The data also indicated that the change in maternal imitation was functionally related to participant completion of the computer training. The evidence for the functional relationship is strengthened by three independent demonstrations where there was an immediate level change in mothers' percent of vocal imitation following the computer training. Participants' performance improved in the absence of individualized coaching or feedback.

Computer-based Training Study Design

The training was designed to include components that may replace the feedback component. Specifically, the OEA was embedded in the training, as prior research indicates that by engaging in such activities, a trainee's subsequent performance may improve (i.e., observer effect). The current study advances the understanding of effective

caregiver training methods by demonstrating that parents can independently improve performance in a contingency-learning game through a combination of ICT training activities, including providing instruction and rationale via video with voice-over narration, rehearsal, OEA, and video reviews with voice-over narration. Because we targeted one specific mother response (vocal imitation), we were able to collect repeated measures and count each individual occurrence of the behavior (Gerencser et al., 2017). This made it possibe to identify a functional relationship between the target response and the ICT. Self-directed computer-based caregiver training programs more commonly include a comprehensive package of learning components and target skills. Skills targeted in past caregiver training studies included both simple and complex parent behavior (Nefdt et al., 2010; Wainer & Ingersoll, 2013). It is also more common when there are multiple target skills to use a treatment fidelity measure as a primary dependent variable, and to score treatment fidelity using a rating scale rather than a direct measure of parent performance. Such studies benefit from evaluating the effect of a training across multiple skills sets, but are limited in their ability to infer functional relations between any one training component, and any one target skill.

Participants averaged 39 min to complete all training components. As a stand-alone training, 39 min may be considered brief. If this training was one learning unit in a series of units, 39 min may be considered lengthy. It may be possible to reduce the time needed to complete the training, while maintaining our observed outcomes. For example, participants completed both rehearsal and data collection activities twice. Multiple exemplar training is important in some skill-based learning; however, it may be that one attempt at each activity may be sufficient to produce similar results. Future investigations

could evaluate the extent to which each individual component and at what dosage was required to maintain the results from the current investigation.

Contingency Learning

The current training activity and methodology to train a parent to engage in the contingency-learning game may be a useful approach to increase infant access to contingent learning interactions. Though it was beyond the scope of the current investigation to analyze data to determine changes in infant behavior, future research should include methods to detect infant contingency learning. One simple addition to the current methodology would be including a still-face-paradigm activity where brief exposure to extinction is added (Cohn & Tronick, 1988). If the infant has learned the contingency, we would expect changes in dimensions of the behavior when the infant experiences extinction, including the possibility of increased negative affective behavior. If the vocal imitation contingency-learning game is effective, future research may also examine if including similar contingency-learning games such as the imitation game, mediates the effect of other interventions that target caregiver responsivity. That is, would caregivers and infants benefit more from intensive caregiver training experiences if they engage in a brief contingency-learning game first?

Social Validity

For research to be considered applied, the behavior or behaviors targeted for change must be related to meaningful changes in the individual's life, and social validity measures should be included in the design to evaluate the social significance of the study results in terms of the acceptability of the procedures used, the process, and the outcomes (Kazdin, 1977; Snodgrass et al., 2018). We evaluated social validity by having three SLP

video-viewer observers (naïve to the session condition) evaluate video examples of mother-infant interactions. See Appendix D for exact instructions.

Video viewers (i.e., SLPs) selected post-training video examples as being the best example of responsive parenting in 6 out of 9 opportunities. The results suggest that even though all mothers engaged in more vocal imitation during post-training clips, video viewers rated three baseline video clips as the better example of responsive parenting. Two out of three SLPs rated Amy’s baseline video clip as a better example of responsive parenting compared to post-training. One video viewer that rated the baseline clip as the better example of responsive parenting commented that during the post-training clip “mom imitated vocalizations and waited for the child to engage, but did not comment on what the child was doing and tune in to small levels of engagement”. We did not provide SLPs with a definition of how to determine the quality of responsivity. It may be that commenting was more valuable for one SLP compared with another. Another explanation for SLPs rating baseline as a better example may be that mothers in post-training clips were trying to engage in a vocal imitation game where they were prompted to imitate all vocalizations. In the natural environment, caregivers do not typically imitate all interactions. A social validity measure that evaluated changes in interaction styles in naturalistic settings, before and after training, may be a more appropriate social validity measure. All video viewers rated Claire’s post-training video as the better example of responsive parenting. One video viewer commented that during the baseline clip the mother seemed to control the interaction and direct play. In contrast, during the post-training clip the viewer noted that the mother was more in tune with her infant’s intentions and followed her infant’s lead more often.

While SLPs did not identify the post-training clip as the better example in every case, SLPs noted that mothers engaged in vocal imitation in their additional comments for all post-training clips, suggesting the change in the mother's target behavior (e.g., vocal imitation) was evident to a naïve observer (see Appendix E for all video viewer comments). The purpose of the current study was to evaluate if mothers increased the use of vocal imitation. All mothers met mastery criteria immediately following training. A future study should evaluate if completing a similar training produces changes in daily caregiver-infant interactions in the natural environment. The SLP ratings suggest that the change in maternal behavior does not necessarily result in better interactions between infant and mother. The SLP comments however, do suggest that the change in maternal vocal imitation was apparent.

Maternal Behavior Improvement Across Sessions

Maternal imitation response patterns suggest that all mother's improved performance across sessions. All mother's imitated during 100% of intervals in their final post-training session. The results may indicate that engaging in the imitation game was important in achieving high performance. Contingency learning research suggests that contingency learning includes an acquisition phase, where a gradual increase in performance is detected while the individual experiences the contingency (Rovee-Collier & Capatides, 1979). Indeed, skill-based learning typically requires a period of acquisition prior to fluent responding (Cooper, et al., 2007). Thus, the improved performance across sessions was not surprising. The improved maternal imitation may also be a reflection of the mother's own contingency learning (e.g.,the infant vocalization became a better signal to the mother to imitate). Furthermore, the infant's behavior during the imitation

game likely contributed to maternal performance. During baseline, all mothers engaged in CCB (Parentese, affirmations, labeling, motor imitation), but infrequently engaged in vocal imitation to infant's vocalizations. Infant contingency learning suggests that when an expected contingency should occur but doesn't, the infant may engage in negative effective behavior (whining, fussing). Because the mother changed her behavior pattern substantially during the imitation game, it may be that initial infant behavior included negative affect, but as the infant detected the imitation-game contingency, the infant may have engaged in more positive affect and behavior that reinforced the mother's vocal imitation. Improved performance overtime, therefore, may be explained by a practice effect, by maternal-contingency detection acquisition, by changes in infant across sessions that may have reinforced or punished maternal responding, or by some combination of all three possibilities. Future research should explore the bi-directional influences on behavior during the vocal imitation game.

Reactivity as a Mechanism of Change

Reactivity may have been a factor contributing to our results (King et al., 2018). Reactivity may have affected participant behavior during training, and during test sessions. That is, all study sessions occurred in a clinical environment, with recording devices visible to the participant at all times. Participants were aware they were being observed during test sessions. Participants were also aware that they were being observed as they completed the training. All participants engaged in all learning activities. If an individual accessed the same training at home, without an individual observing, they may not engage in all activities. During test sessions, the participants were also aware they were being observed. It is possible they engaged in the target response because of the

setting and the awareness of being observed (reactivity). Thus, the current training may only be effective in a controlled environment that includes observers. We are unable to speculate if the identical content delivered using other modalities, and under other conditions would produce similar results. Reactivity may be a critical variable that explains the observer effect phenomenon (King et al., 2018).

The purpose of the current investigation was to identify a training methodology that is effective even when completed independently and without feedback. If reactivity, or, the awareness of being observed, is a critical variable when using observer effect components, it may be necessary to identify additional strategies for building in reactivity within asynchronous independent trainings. Future investigations are needed to evaluate the effect of the training when it is consumed in a truly independent environment. If future investigations find that reactivity is a necessary component, service delivery systems may arrange trainings that would predict reactivity.

The results from the current investigation indicate that when a participant engages in all activities within the training, a systematic change in their imitative behavior occurred. While future research should evaluate the effects of current training methodology when delivered on-line, the findings suggest that delivering the training in a clinic space may be effective, even when there is no feedback or coaching from a professional. Therefore, a facilitator could be hired to help a parent set-up a practice space, set-up the computer training, and allow the parent to learn the parenting skills without needing to hire a highly trained therapist. In such a service delivery model, video from sessions could be reviewed by a therapist at a later time, and feedback could be provided asynchronously, or via a phone call with parent and therapist. In other words,

the training could be delivered in a similar way, and used as a stand alone training, or as a supplement to a coaching model. Future research should also consider evaluating the training modality with childcare providers, as many young children, including infants, spend many hours in the day in the care of non-family members. The training modality in the current study may also be an effective way to train personnel in childcare environments, including Head Start programs. Future research could also explore ways to disseminate similar training at a population-level (Darcy Mahoney et al., 2019). For example, future research could evaluate the effect of embedding trainings similar to the one we used in the current study within settings frequently accessed by caregivers, such as pediatric clinics, or community school. That is, community organizations could provide opportunities for caregivers to engage in similar trainings within clinic waiting rooms, or within a school setting prior to a teach conference.

Limitations

There are a few important limitations to discuss. First, the current investigation was not designed to isolate the effect of the OEA or any other training component on maternal vocal imitation. We therefore cannot infer which components of the training were functionally related to the change in parent behavior, nor can we infer if any of the components are unnecessary. Future studies could include methodologies that are designed to analyze the effect of OEA on performance. OEA could be evaluated across a gradient of target behavior difficulty.

A second limitation is that the current investigation targeted only one simple parent response. We can only hypothesize that the training methods will also be effective for complex target behaviors (e.g., expansions, object labeling), or for a training that

targets multiple parent behaviors at once (e.g., teaching all responsive parenting techniques). As noted previously, self-directed ICT studies have produced mixed-results, where participants required direct feedback components in order to reach mastery. This may be due to the complexity and breadth of such training packages. For example, imitation may be an easier target response than a target response requiring the parent to label and describe their infant's behavior. Imitation may be easier because there is a one to one correspondence between stimlus and response. The caregiver must learn only to discriminate the infant vocalization, and respond by performing a similar topographical response. In order for a caregiver to label a child's action in line with the child's focus, the caregiver must discriminate stimuli associated with the child's point of focus, then respond using an asymmetrical response. In some cases, it may be difficult to label subtle or ambiguous infant behavior. We designed the current investigation to be completed asynchronously and without feedback. In addition to increasing the complexity of the target response, another future direction may be to evaluate the effect of training when multiple skills are presented all together, or one skill after another. Video coding may be effective for simple discrimination and responding. It may be less effective, or require more exemplars to be effective for more complex behavior targets. Future research could evaluate how many behaviors a training can target before seeing a plateau in performance.

A third limitation is our generalization measure. We included one generalization probe session during all phases in the study. During the generalization probe, mothers interacted with their babies while their baby was seated in the stroller. The purpose of the generalization probe was to evaluate if mothers would continue engaging in the target

response in a different location. We did not measure if the mothers engaged in vocal imitation outside of the clinic setting. Furthermore, the stroller and high chair may have been too similar to measure generalization. That is, in both contexts, the mother and infant were sitting face-to-face in an identifical session room. Future studies should include generalization probes in settings outside of the training contexts. It may also be important to evaluate the training when environmental variables are manipulated, such as adding background conversations, including other distracting activities in the environment that may effect the degree to which a mother imitates her infant following training. Results from more naturalistic environments will provide a better indicator of generalization to natural environments.

A fifth limitation was that our analysis was limited to maternal imitation and a rudimentary count of infant vocalizations. We did not evaluate infant behavior to detect if contingency learning occurred within and across the contingency-learning vocal-imitaiton game. Future analyses could be designed to specifically measure the effect of the mother's contingent behavior on infant behavior. Furthermore, future studies could include an extinction phase following caregiver mastery of the target response, where infant vocalization no longer produces maternal vocal imitation.

A final limitation is the setting in which the training occurred may have produced responding under environmental stimulus control that was unrelated to the training. The training occurred in a clinic in which cameras were visible during sessions, and participants were aware that a researcher was present and observing. During training components, participants were prompted to interact with training activities. For example, during the rehearsal activity, participants were prompted to practice imitating a baby

babbling in a video. If the participants completed the training on-line outside of an observed, clinic setting, it is possible they would not engage in all of the learning activities. Moreover, following training activities, participants immediately engaged in sessions, and were instructed to "incorporate strategies learned in the training". The immediate practice of the skill with their infant may be an essential component. Future research should evaluate how each component of the training relates to changes in parent behavior. Future research should also evaluate if the training is effective when it is delivered on-line.

Conclusion

Caregiver responsivity supports healthy infant development across developmental domains because responsivity facilitates infant contingency learning (Gilkerson et al., 2017; Tamis-LeMonda et al., 2001). In the current study, mothers learned how to complete a contingency-learning game (i.e., vocal imitation game) by completing an ICT in under 45 min, and without any direct feedback or coaching. Results advance the understanding of effective caregiver training methods by demonstrating that parents can independently learn specific skills through ICTs that include videos with voice-over narration, video modeling, rehearsal, and OEA. The current investigation contributes empirical evidence for a methodology that has the potential to reduce dissemination costs and lower human resource-requirements when training caregivers to engage in contingency-learning games. Caregiver implementation of a vocal-imitation contingency-learning game has the potential to catalyze a positive infant-caregiver feedback loop. More research is needed to identify how the game may change both infant and caregiver behavior over time.

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Appendix A

Training Transcripts

Training Cover Page

START HERE: Parent Training Welcome Page

Welcome to Mother-Infant Play training!

In this training, you will learn about parenting strategies that support your infant's development. The specific learning target for this training is vocal imitation.

Learning Objectives

By the end of this module, you will be able to:

- describe responsive parenting
- describe why responsive parenting is helpful for infant development
- play "Imitation Game" with your infant to encourage babbling

Schedule for the training

Module 1: Vocal Imitation	3.5 minutes
Module 2: Rehearsal	6 minutes
Module 3: Observation and Evaluation	10.5 minutes
Module 4: Review	4.5 minutes
Total Time	24.5 minutes

Module 1.

Module 1: Vocal Imitation

Module 1 - Early Infant Communication and Development

The following activities will describe typical infant communication and overall development. Remember that to complete each task to move onto the next module, you will need to click the "complete button" shown in the picture below:

Activities to Complete:

Task	Description	Time
1	Vocal Imitation	3:15
	Time to Complete:	3:15

>The target skill of this training is vocal imitation of your baby's vocalizations.

>First, I want to introduce you to responsive parenting. Responsive parenting is a great approach to support your baby's development. Vocal imitation is one responsive parenting strategy. When I say responsive parenting, it's just as it sounds. When your baby behaves, you immediately, or soon after, engage in a behavior that is related to your infant's behavior. Essentially, you are responding to your baby.

>When you consistently respond to your baby, they begin to learn that their behavior causes a predictable change in your behavior.

>They also begin to learn that the world is orderly and predictable, which allows them to naturally learn from their environment faster.

>Responsive parenting also helps your baby learn to communicate better. And that may prevent problem behavior down the road.

>As I mentioned, vocal imitation is a great responsive strategy. It teaches your baby that they are making a change in the environment. It also gives your baby a model for more complex vocal sounds. Have you noticed that your baby is trying to imitate you sometimes?

>Another great strategy is responding to your baby using Parentese, that caring sing-songy voice that you use when talking to children or babies.

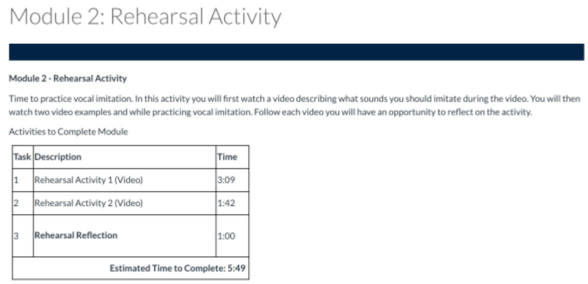
>Here is an example of vocal imitation [video clip]

>And this example shows Parentese, where the mom is kind of mimicking a conversation with her baby [video clip]

>Imitating your baby will not only help your baby learn, it can also become a really fun game you can play with each other. And you can help your baby learn new behaviors by imitating each other back and forth. Here is an example of a father and daughter playing the imitation game. [video clip]

>Our next activity is rehearsal, where you'll practice imitating the baby on the screen.

Module 2: Rehearsal Activity


Module 2: Rehearsal Activity

Module 2 - Rehearsal Activity

Time to practice vocal imitation. In this activity you will first watch a video describing what sounds you should imitate during the video. You will then watch two video examples and while practicing vocal imitation. Follow each video you will have an opportunity to reflect on the activity.

Activities to Complete Module

Task	Description	Time
1	Rehearsal Activity 1 (Video)	3:09
2	Rehearsal Activity 2 (Video)	1:42
3	**Rehearsal Reflection**	1:00
	Estimated Time to Complete: 5:49	

Script Video 1

>Now it’s your turn to practice imitation.

>Here are a few reminders. First, try to imitate all of the baby’s vocalizations that mimic a vowel or consonant sound.

>Ignore other sounds such as laughter, hiccups, coughs, sneezing, growling, etc.

>If the baby is doing a combination of growling and a vowel/consonant sound, always provide the good communication model. So, if they sound like a pirate, ARGH, then you can sound like a mom in the middle of a meditation ahhh.

>Try to imitate as soon as the baby pauses in silence. This will help the baby solidify the connection that your behavior is related to their behavior.

>If the baby in the video vocalizes for a longtime, like longer than 2-3 seconds, just try to imitate the last chunk of the vocalization.

>After imitating, do your best expectant look, signaling to the baby that you’re waiting, and it’s their turn to keep the conversation going.

>So here is a disclaimer. I understand that this activity may make you feel uncomfortable. Remember, the process of practice in skill-based learning, is essential for acquiring the skill. So, if you feel a little weird imitating a screen, recognize that you are feeling that, and then go ahead and do your best impersonating. You got this!

>[video clip 1:00]

>Phew. All done. How did it go? Was it easy for you to imitate all of the sounds? Did it feel uncomfortable? How did it go for you?

Script Video 2

>Okay, you have practiced imitating one video. Here is one more video to practice.

>First you will practice imitating just like you did on the last video. Then you will have an opportunity to reflect on the experience. Then our next step in the training is to start collecting some data.

>[Video Clip 1:00]

>On the next page you will have an opportunity to reflect on your experience.

Reflection Question

Describe your experience with the activity. Was the activity easier the second time. Did you have any new thoughts during the activity?

Module 3: Observation and Evaluation Activity

Module 3: Observation and Evaluation Activity (10:41)

Module 3 - Observation and Evaluation Activity

In this activity you are going to be the data collector. On the next page you will watch a video for how to complete the data collection assignment.

Activities to Complete Module

Task	Description	Time
1	Introduction to Activity (Video)	2:21
2	**Assignment 5a - GoReact 1**	1:00
3	GoReact 1 Feedback (Video)	1:43
4	**Assignment 5a - GoReact 2**	1:00
5	GoReact 1 Feedback (Video)	2:37
6	**Assignment 5c (Reflection)**	2 minutes
		Estimated Time to Complete: 10:41

GoReact 1 Video commentary Script

>Okay, that's the first one that I heard. You can see it pops up right here. There's another one. So, there is a lot that could be imitated, but not are getting imitated, right. But a lot of imitation is happening. Okay wow, so I came up with 13, what did you come up with? Now you'll notice here is there is a feedback graph. These are all of the instances that I clicked that vocal imitation happened. Over here you can click and go back to the spot [in the video] that you marked. You'll also notice that at the very beginning of the video you here an adult vocalization that sounds like imitation [replays referred clip section], but there wasn't a sound from the baby to start the session, right? So, I only marked it when the baby first made a sound, and then there was imitation that followed. So, for this one I got 13. What did you get? Were you close?

GoReact 2 Video commentary script

> Notice I've added the comment tracker down here, so every time that I mark a vocalization, it should pop up here with a red button. And again, I'm going to hit the red button. I can hide the graph, but I want you to see each time I pushed it. So, I'm going to click the red V I hear vocal imitation. Okay, great. So, it looks like I got 8 instances of vocal imitation. Did you get 8? Maybe you didn't count, there was one that sounded kinda like a laugh, and in this video, they imitated it, so if you're marked that or not, it's okay. One thing you'll notice is that in this video is that the baby is using some of that kind of pirate sound, right, like "argh", and the adult is imitating with a nice smooth vowel sound ahhh, so remember when you're vocally imitating, that's what we're looking for, to give the good model of a vocalization, and so your baby will imitate you back with that more smooth vocalization. So again, I got 8, see what you got, and see if we got the markings at the same time.

Reflection Question:

Describe any thoughts you had while engaging in the data collection activities. Did you like this activity? Does it feel like it will be helpful for using vocal imitation with your baby?

Module 4: Course Conclusion

Course Conclusion (4:18)

Course Conclusion

You have reached the end of the course. Well done! Watch this wrap-up video that reviews the keys concepts you learned throughout the training. The video will also describe the vocal imitation challenge we have for you in the sessions that follow this training. And as always, you will have another opportunity to reflect. You will also have space to leave feedback that our research team can use to improve upon the modules.

Thank you for your participation!

Activities to Complete Module

Task	Description	Time
1	Course Review (Video)	2:18
2	**Assignment 6 (Reflection)**	2:00
	Estimated Time to Complete:	4:18

Course Review – Script

>We’re almost done with the training, time for a brief review.

>First, babies learn that when they behave, you behave. The baby learns that they are effective. Baby’s learn they are effective when you are responsive to their behavior. This is called responsive parenting. Baby behaves, parent responds.

> Parentese is one type of responsive parenting. Parentese is the sing-songy way that you naturally speak with your baby. *ooh, high, yeah.* Kinda like that.

>Vocal imitation is another great responsive parenting technique where you model the vocalizations your baby makes. Pretty soon, your baby will be imitating you, a lot!

>Remember when playing the imitation game, to give your baby a good model *argh, argh*. If your baby is a pirate, you are the meditation guide *ahh, ahh.*

>At home, you don’t need to imitate your baby constantly. But you can mix-in imitation throughout the day. Think of it as a conversation you are having with your baby. Your baby says “babababa” and you respond with “babababa? *prosody to indicate question”* Like a question. See how long you can keep the conversation going.

>And now we are nearing the end of the training. Before we move to our play sessions, please spend a moment to give us feedback about what you found helpful with the training and how the training could be better. Your feedback will help us improve the training for the next families who participate.

>At the end of the training, we’re going to go back and do a few more play sessions like the ones we did before the training. During the play session, I want you to try out the imitation game with your baby. Remember to imitate all of your baby’s vocalizations. And, wait for the baby to pause and imitate right after. Most of all, smile and have fun with your baby.

>And thank you again for participating in this training.

Course Feedback

1. What were your favorite components of the training?
2. How can we make the training better for future participants?
3. What is one area of your infant learning that you want to know more about next?
4. Any other comments, questions, feedback about this course?

Appendix B

Mother comments during training

Participant 1	Participant 2	Participant 3
Rehearsal Activity Describe your experience with the activity. Was the activity easier the second time. Did you have any new thoughts during the activity?		
The experience was a little awkward, but very easy for each practice. I'm very comfortable when interacting with my own child. During the second round I wasn't sure whether to make a "ba" sounds or a "va" sound.	Once I startee doing it, it wasn't as bad as I thought it would be. I naturally wanted to respond to the baby, but was struggling to repeat what they were saying, this especially goes for the second video. The first one, it was almost like they were waiting for a response, but then in the second, she just seemed to be babbling to herself. It was harder for me to imitate that type of talking.This just gets me thinking of when I may or may not have talked back, but realizing iti s a positivie thing all the time	I felt a little less awkward the second time. It was definitely easier. The second time felt more natural.
Observer Effect Activity Describe any thoughts you had while engaging in the data collection activities. Did you like this activity? Does it feel like it will be helpful for using vocal imitation with your baby?		
The activity was clear and easy to practice. It was nice being able to collect my own data and then review what the instructor had found, that gave me the confidence that I nderstood the concept and could demonstrate it accurately.	I liked the activity so I could recognize when would be imitation, but I did feel it was a little repetitive doing it twice, because I did understand it the first time. I feel it won't greatly help with my baby, but I feel it does help the process as a whole.	It was helpful to see what you marked as vocal imitation, also to hear your comments at the end about getting a nice smooth vowel sound. I liked this activity. I felt like i was slow marking the "V" especially on the second video when there was lot of imitation going on. This will be helpful when interacting with my baby.
Course Conclusion - What were your favorite components of the training? How can we make the training better for future participants? Additional comments?		
The Videos No comment. Training had a good format and very clear. Great training!	Learning about the different ways you can communicate with my baby. I loved that is said to just have a conversation with your baby, but in their language. I thought it was an effective training, but doing it was interesting to see. It was just such a simple task, I don't know why people would have more or less marks then the trainer did.	I like it all. I feel like it was all helpful. Some of the instructions aren't super clear. I am not super computer savvy so it could be me as well.

Note. Responses above are direct statements from mothers. No editing for grammar or meaning were made to submissions.

Appendix C

Mother comments in post-study survey

Participant 1	Participant 2	Participant 3
Rank the learning components in order of most helpful to least helpful (how helpful was this component?)		
Rehearsal (Very helpful) Data Collection (Very helpful) Information (Somewhat helpful)	Information (Very helpful) Rehearsal (Somewhat helpful) Data Collection (Somewhat helpful)	Data Collection (Very helpful) Information (Very helpful) Rehearsal (Very helpful)
Training was easy to understand - I enjoyed the training -I would recommend this training to others		
Strongly agree Strongly agree Strongly agree	Strongly agree Agree Strongly agree	Agree Agree Agree
What were things you enjoyed about the training?		
Practicing identifying vocal imitation	I enjoyed the information about how this could help my child, and also enjoyed seeing it in action through some of the videos.	I thought the videos were help. Especially the part where you told us what you were counting as a Parentese. I enjoyed learning that now my baby should be learning this way and eventually will mimick us.
If you could change the training in any way to make it better for the next parent, what would you do?		
A little bit more clarity on how to imitate more correct sounds back to my baby. Ex: when my baby says "babavayagg", should I focus on the B or the G sound.	The data collection portion didn't seem to be needed, and if it is, then maybe only once.	I would use different videos for the information section than you do for the practice video. I had already seen and heard the baby so for some reason it made it more difficult to rehearse on that one.
If you have any other additional comments, please include them here.		
Overall great training!		Thanks for letting us come and play!

Note. Responses above are direct statements from mothers. No editing for grammar or meaning were made to submissions.

Appendix D

Instructions to video viewer

Purpose

The purpose of your participation in this study is to provide an expert perspective of participant responding. Participants in the study have completed a self-directed computer training to teach interaction strategies that they can use with their baby.

Instructions:

You will watch 3 video clips. Each video clip includes a pre-training, and a post-training sample for the participant. Pre- or post-training clips may come first or second.

For each clip, you will select which session clip (1st or 2nd) was a better example of responsive parenting behavior. You will watch each clip one time.

Because you are an expert in speech and language development, if you notice any other notable moments from either clip related to the infant-mother interaction, please include those thoughts in the open-ended section.

Appendix E

Video viewer comments

VV	Amy	Jo	Claire
1	****1st: baseline**** "mom imitated movements, sounds, and gave meaning to gestures (she gave meaning to the child handing to the toy to mom). She followed the child's lead and was in tune to the child's interests." **2nd: post-training**: "mom imitated vocalizations and waited for the child to engage, but did not comment on what the child was doing and tune in to small levels of engagement (e.g., the child mouthed the book and was interested in it, but mom did not respond)."	**1st: post-training** "Mom did well at imitating vocalizations of the child, but missed opportunities to engage with the child's interests (when the child looked away at other things, joining in the child's play, responding to and interpreting silly sounds, etc". ****2nd: baseline**** "Mom joined in the child's interactions, especially experiencing shared emotions with the child. She commented and interpreted the child's movements, sounds, and play. She and the child seemed to enjoy the interaction more."	**1st:baseline** "Mom joined in the play with the child, but at times took over the interaction rather than responding to the child's interests (e.g., peek-a-boo). She had nice facial expressions in response to the child's movements and excitement." ****2nd:post-training**** She followed the child's lead more in the interaction and imitated and commented on observations.
2	****1st: baseline**** Clip 1 great job imitating gestures, back and forth vocal play (turn taking), good wait time, using fun sounds, great prosody and enthusiasm, good "anticipated waiting" **2nd: post-training** Clip 2 good wait time, seems more at eye level, great imitating vocalizations!! Both were great interactions. It was hard to pick. I liked a lot of what happening in clip 1. There was a lot of great back and forth interactions. I like that mom was so clear with her imitations in clip 2 and she felt much more confident (which makes me think I may have picked the wrong one).	****1st: post-training**** Clip 1 great imitations, great getting at eye level, great "anticipated" wait, great prosody and facial expressions, leaning in, nodding **2nd: post-training** good imitating, repetitions, good wat time. Touch choice. Both clips were very responsive. Great job Mom!!	**1st: baseline** clip 1: fun playing and interacting ****2nd: post-training**** clip 2: great facial expressions and vocal prosody, great responding and commenting on what the child is interested in, great imitating vocal sounds and actions, great using fund sounds and words.
3	**1st: baseline** In clip 1 mom imitated lots of the actions, but did not add many words into the interactions. ****2nd: post-training**** In clip 2 mom imitated sounds as well as using words to talk about the book.	****1st: post-training**** Both sessions were really good but mom was more consistent in imitating him in the first clip.	****2nd: post-training**** Mom was more consistent in imitating sounds in the second video.

Note. Responses above are direct statements from VVs. No editing for grammar or meaning were made to submissions.

Appendix F

Procedural Fidelity Checklist

Video #	Summary Divide total checks by 5 to get % implementation
Video 1 ☐ Child in high chair during session ☐ Mother in chair during session ☐ Implementer out of room for entire session ☐ Audio available for entire session ☐ Implementer does not interact through audio for entire session	Total checks: % Implementation:
Video 2 ☐ Child in high chair during session ☐ Mother in chair during session ☐ Implementer out of room for entire session ☐ Audio available for entire session ☐ Implementer does not interact through audio for entire session	Total checks: % Implementation: Saved

Appendix G

Treatment Integrity Data Collection

Shea Dissertation Training Procedural Integrity

Participant Dyad #: ________ Date: ________ Start: ________ End: ________

Total time in training: ____________________ Data Collector Name: ____________________

Circle one: Primary / IOA

Participant Training Fidelity

Yes/no	Step Description	Notes
	Introduction and Module 1	
	- Complete Introduction Survey	
	- Module 1 Video (views all)	
	Module 2: Rehearsal	
	- Rehearsal Activity 1 (engages in vocal imitation)	
	- Rehearsal Activity 2 (engages in vocal imitation)	
	- Completes Rehearsal Reflection	
	Module 3: Data Collection	
	- Watches instructions for Data Collection	
	- GoReact 1: Collects Data	
	- Watches Feedback for GoReact 1	
	- GoReact 2: Collects Data	
	- Watches feedback for GoReact 2	
	- Completed Reflection Survey	
	Course Conclusion	
	- Watches conclusion video	
	- Completes course survey	

Participant Training Fidelity

Yes & Correct Total ______
No & Incorrect Total ______

Overall Total Opportunities _____

Divide (correct) / (overall) * 100. = _________ % correct fidelity of Training Fidelity

Appendix H

Interobserver Agreement Data Collection

Date of Session:

Session Start:

Session End:

Intvl	Child	#	Parent
START	Yes/No		Yes/No
:11-:20	Yes/No		Yes/No
:21:30	Yes/No		Yes/No
:31-:40	Yes/No		Yes/No
:41-:50	Yes/No		Yes/No
:51-1:00	Yes/No		Yes/No
1 MIN	Yes/No		Yes/No
:11-:20	Yes/No		Yes/No
:21:30	Yes/No		Yes/No
:31-:40	Yes/No		Yes/No
:41-:50	Yes/No		Yes/No
:51-2:00	Yes/No		Yes/No
2 MIN	Yes/No		Yes/No
:11-:20	Yes/No		Yes/No
:21:30	Yes/No		Yes/No
:31-:40	Yes/No		Yes/No
:41-:50	Yes/No		Yes/No
:51-3:00	Yes/No		Yes/No
3 MIN	Yes/No		Yes/No
:11-:20	Yes/No		Yes/No
:21:30	Yes/No		Yes/No
:31-:40	Yes/No		Yes/No
:41-:50	Yes/No		Yes/No
4 MIN	Yes/No		Yes/No
:11-:20	Yes/No		Yes/No
:21:30	Yes/No		Yes/No
:31-:40	Yes/No		Yes/No
:41-:50	Yes/No		Yes/No
:51-5:00	Yes/No		Yes/No

This data sheet is a 10-second partial interval data collection. Please read instruction below.

Instructions:

During the video session, you will see a video of a baby and an adult. The video will beep every 10 seconds.

1. For the first child vocalization, circle Yes in column 2, write a 1 (indicating the first vocalization).
2. Circle yes if adult imitates during the interval.
3. When you hear the beep, move to the next interval.
4. Child vocalization or parent imitation that occurs with the beep will count for the next interval.

Definitions:

Child Vocalization:

Any instance of child vocalization lasting 1-sec. Non-examples: Vegetative noises, cries, screams.

Parent imitation:

- Any instance of parent producing a topographically similar utterance within 2-secs of child utterance.
- If a parent imitates within 2-secs but during a new interval, count the imitation in the interval in which the child vocalization occurred, and write an asterisk next to the number.

It is okay to mark intervals in which you are unsure, and re-watch again.

Totals:

Total Intervals: ___________

Intervals to 10 vocalizations: ___________

Parent imitation first 10 vocalizations: _________

IOA:

Agreements: _________ Disagreements: ___________ Total: ___________

IOA: Agreements/Total. ___________/__________ = __________ % agreement

Participant ID: ____. Session Number:___________ IOA/Primary _______

Appendix I

Session scoring examples

Session scoring examples

Example A

When an infant vocalization occurs across intervals

1. Infant begins vocalizing at 18 seconds (Interval 2). The infant stops vocalizing at 23 seconds (Interval 3).
    a. The infant does not vocalize again in Interval 3. Infant vocalization is scored for **Interval 2**, not **Interval 3**.
    b. The mother imitates the infant at 24 seconds (Interval 3).
        i. The maternal imitation is scored for imitating the infant during **Interval 2** (The interval in which the vocalization began), not Interval 3, the interval in which the vocalization ended.

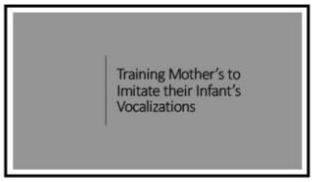
Example B

When an infant vocalization occurs during a different interval than maternal imitation

2. Infant begins vocalizing at 17 seconds (Interval 2). The infant stops vocalizing at 19 seconds (Interval 2).
    a. . Infant vocalization is scored for **Interval 2**
    b. The mother imitates the infant at 21 seconds (Interval 3).
        i. The maternal imitation is scored for imitating the infant during **Interval 2** (The interval in which the vocalization began), not Interval 3, the interval in which maternal vocalization occurred.

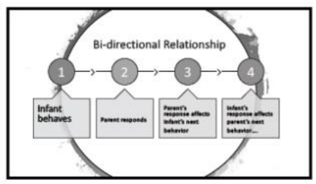
Appendix J

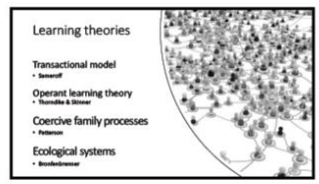
PowerPoint Slides from Dissertation Meeting


Training Mother's to
Imitate their Infant's
Vocalizations

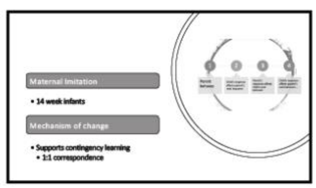

Infants learn
through
interactions
with their
environment.


Contingent responding

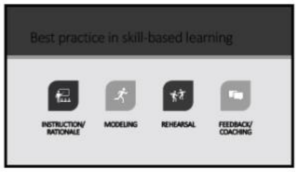

Bi-directional Relationship
1
2
3
4
Infant behaves
Parent responds
Parent's response affects infant's next behavior
Infant's response affects parent's next behavior...


Learning theories
Transactional model
• Sameroff
Operant learning theory
• Thorndike & Skinner
Coercive family processes
• Patterson
Ecological systems
• Bronfenbrenner

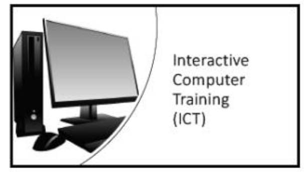

Vocal imitation

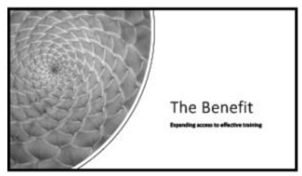

Maternal Imitation
• 14 week infants
Mechanism of change
• Supports contingency learning
• 1:1 correspondence

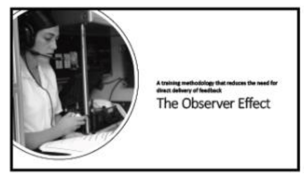

Training Vocal
Imitation

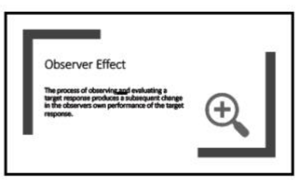

Best practice in skill-based learning
INSTRUCTION/ RATIONALE
MODELING
REHEARSAL
FEEDBACK/ COACHING

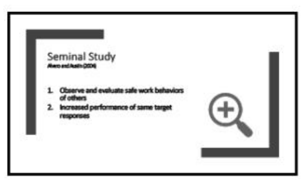

Dissemination Barriers


Interactive Computer Training (ICT)


The Benefit
Expanding access to effective training

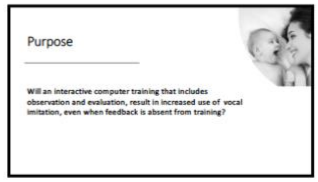

A training methodology that reduces the need for direct delivery of feedback
The Observer Effect

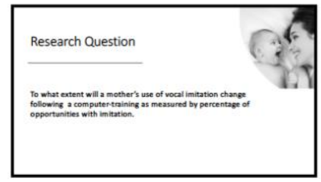

Observer Effect
The process of observing and evaluating a target response produces a subsequent change in the observers own performance of the target response.


Seminal Study
1. Observe and evaluate safe work behaviors of others
2. Increased performance of same target responses


Caregiver Training
• Parents using compliance training w/ their child with a disability

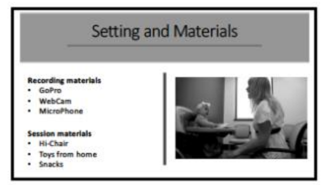

Mothers and infants
Vocal imitation


Purpose
Will an interactive computer training that includes observation and evaluation, result in increased use of vocal imitation, even when feedback is absent from training?

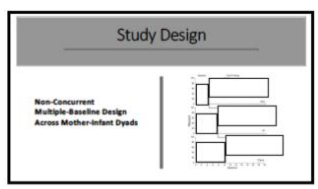

Research Question
To what extent will a mother's use of vocal imitation change following a computer-training as measured by percentage of opportunities with imitation.

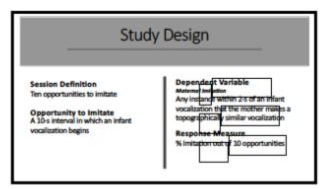

Methods


Amy & Kirsten
Jo & Ryder
Claire & Beth
Mother
• English-speaking
• First-time mother
• College educated
• 25, 26, 31 years
Infant
8 months, 4 days Female
8 months, 9 days Male
9 months, 28 days Female


Setting and Materials
Recording materials
• GoPro
• WebCam
• MicroPhone
Session materials
• Hi-Chair
• Toys from home
• Snacks

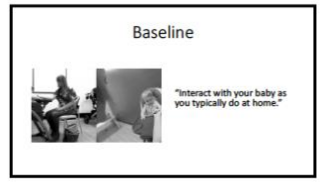

Setting and Materials
Generalization Probe
• Stroller (from home)

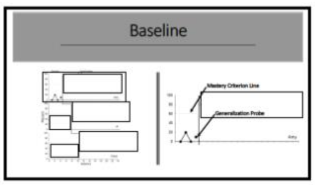

Study Design
Non-Concurrent
Multiple-Baseline Design
Across Mother-Infant Dyads

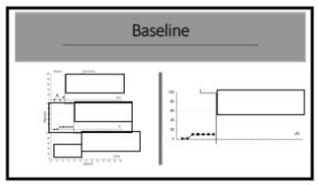

Study Design
Session Definition
Ten opportunities to imitate
Opportunity to Imitate
A 10-s interval in which an infant vocalization begins
Dependent Variable
Response Measure

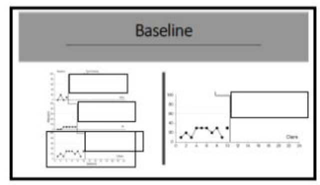

Reliability Measures
Session Implementation Fidelity
Interobserver Agreement
• Point by Point
Training Fidelity
• 100%

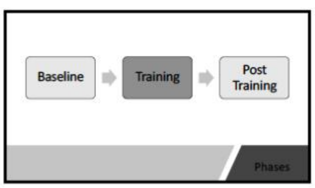

Baseline
Training
Post Training
Phases

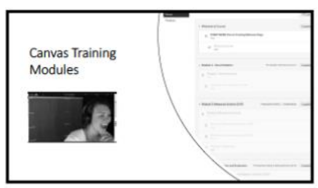

Baseline
"Interact with your baby as you typically do at home."


Baseline
Mastery Criterion Line
Generalization Probe

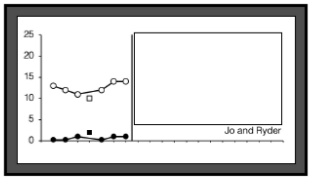

Baseline

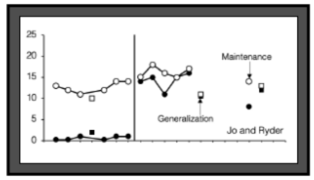

Baseline

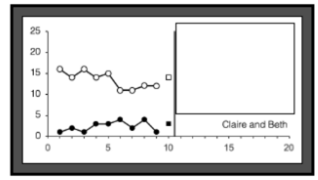

Baseline
Training
Post Training
Phases

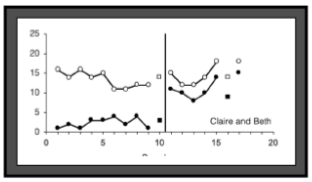

Canvas Training Modules

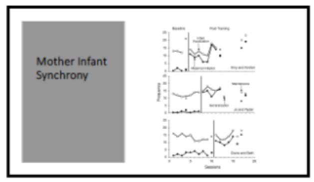

Interactive Computer Training
INSTRUCTION/ RATIONALE
MODELING
REHEARSAL
FEEDBACK/ COACHING

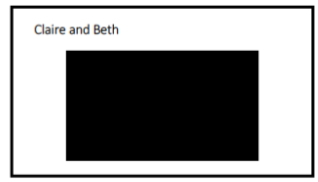

Jo and Ryder

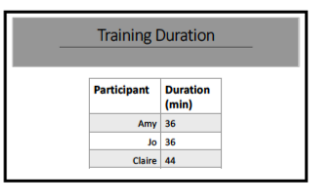

Maintenance
Generalization
Jo and Ryder

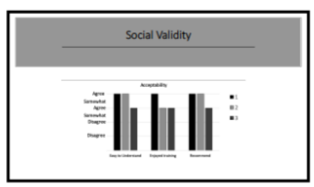

Claire and Beth

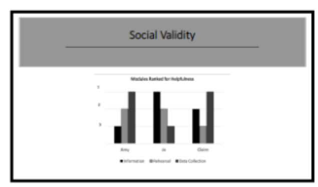

Claire and Beth


Mother Infant Synchrony

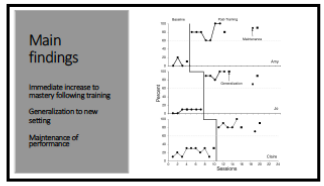

Claire and Beth

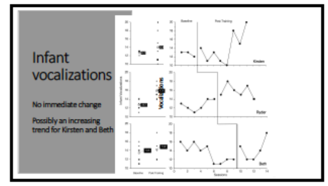

Training Duration
Participant | Duration (min)
Amy | 36
Jo | 36
Claire | 44

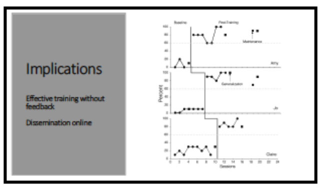

Social Validity

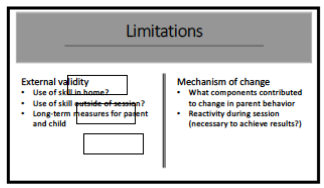

Social Validity

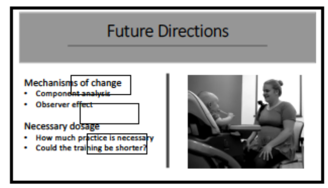

Discussion

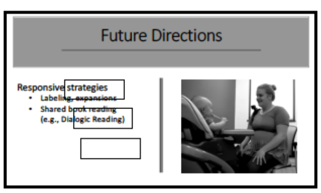

Main findings
Immediate increase to mastery following training
Generalization to new setting
Maintenance of performance
Baseline
Post-Training
Maintenance
Generalization
Percent
Sessions
Amy
Jo
Claire

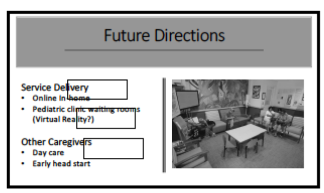

Infant vocalizations
No immediate change
Possibly an increasing trend for Kirsten and Beth
Baseline
Post Training
Kirsten
Beth
Sessions


Implications
Effective training without feedback
Dissemination online


Limitations
External validity
Use of skill in home?
Use of skill outside of session?
Long-term measures for parent and child
Mechanism of change
What components contributed to change in parent behavior
Reactivity during session (necessary to achieve results?)


Future Directions
Mechanisms of change
Component analysis
Observer effect
Necessary dosage
How much practice is necessary
Could the training be shorter?


Future Directions
Responsive strategies
Labeling, expansions
Shared book reading (e.g., Dialogic Reading)


Future Directions
Service Delivery
Online In home
Pediatric clinic waiting rooms (Virtual Reality?)
Other Caregivers
Day care
Early head start


Acknowledgements

Curriculum Vitae

Kerry A. Shea

PERSONAL INFORMATION

Email: kerry.shea@aggiemail.usu.edu

EDUCATION

PhD (student) 2019 *Anticipated*	Applied Behavior Analysis – Disabilities Discipline Program Utah State University, Logan, UT Advisor: Dr. Tyra Sellers PhD, BCBA-D Dissertation Topic: Computer-Based Parent Training to Teach First Time Mothers to Vocally Imitate their Infant Baby
M.Ed. 2015	Utah State University, Logan, UT Major: Special Education Chair: Dr. Lillian Duran PhD Master's Project: "A Professional Development Training for Head Start Teachers Serving Dual Language Learners
B.A. (Hon) 2006	University of St. Thomas, St. Paul, MN. Major: Spanish Minor: Community Health Education

PROFESSIONAL CERTIFICATION

- BCBA (#1-15-20165) (2015-present)
- Licensed Behavior Analyst with the State of Utah (#10834832-2506)

PROFESSIONAL SOCIETIES

- Association for Behavior Analysis International (2015-present)
- Utah Association for Behavior Analysis (2015-present)

HONORS & AWARDS

2018-2019 Utah State University, doctoral fellowship. Full scholarship to attend doctoral program in applied behavior analysis and $25,000 yearly stipend provided to assist in research activities and teaching undergraduate and master's level courses.

2017-2018 Frederick Q. Lawson Fellowship from the Utah State University: College of Education and Human Services for $5,000.

2017-2018 Utah State University, doctoral fellowship. Full scholarship to attend doctoral program in applied behavior analysis and $25,000 yearly stipend provided to assist in research activities and teaching undergraduate and master's level courses.

2016-2017 Utah State University, doctoral fellowship. Full scholarship to attend doctoral program in applied behavior analysis and $20,000 yearly stipend provided to assist in research activities and teaching undergraduate and master's level courses.

2015-2016 Utah State University, doctoral fellowship. Full scholarship to attend doctoral program in applied behavior analysis and $20,000 yearly stipend provided to assist in research activities and teaching undergraduate and master's level courses.

2016 Utah Association for Behavior Analysis, research award for poster entitled "Telehealth and Functional Communication Training for Toddlers Receiving Part C Early Intervention Services".

2011-2012 Utah State University, master's level research assistantship. Full scholarship to attend master's program in special education and $12,000 yearly stipend provided to assist in research activities.

2010-2011 Utah State University, master's level research assistantship. Full scholarship to attend master's program in special education and $12,000 yearly stipend provided to assist in research activities.

RESEARCH AND CLINICAL EXPERIENCES

Research Experience

Research Project Lead (2014-present)

- Parents running functional analysis procedures with their toddlers who engage in severe problem behavior (2014).
- Evaluation of implementation language on functional analysis outcome (2015).
- Evaluation of a computer-based training to teach novice excel users how to create line graphs with embedded phase change lines (2018).
- Evaluation of a computer-based training to teach parents how to incorporate vocal imitation with their infant (*on-going)*.

Project contributor

- Evaluation of Behavior Skills Training to Teach Direct Care Staff to Implement Preference Assessment Procedures (2018).
- Evaluation of Expert Video Modeling to Train Rock Climbers Safer Climbing Technique (2018).

Behavioral Consultant

Kids on the Move 2019-present

- Provide direct supervision of in-home therapy for children and adolescents with ASD
- Registered Behavior Technician (RBT) manager

Utah Professional Development Network (UPDN) 2018-2019

- Supported the district personnel across Utah to implement evidence-based behavior interventions for students in the district through training and year-long virtual communities of practice coaching

Center for Persons with Disabilities (CPD) 2018-2019

- Through the Inter-agency Outreach Training Initiative (IOTI) grant, developed behaviorally-based parent trainings delivered via on-line course.
- Facilitated learner discussions and live webinars

Granite School District 2015-present

- Supported the district behavior team to implement evidence-based behavior interventions for students in the district.
- Systems management
- Process management
- Pyramidal coaching models

Part C – Up to 3 Early Intervention 2013-2016

- Directly worked with families to implement behavior support plans for their children under 3 years old

Doctoral Fellow – Case Manager

Utah State University – Utah Behavior Support Clinic 2015-2019

Lead Case Manager

Autism School, Education, Research, Teaching (ASSERT) 2012-2014

ARTICLE PUBLICATIONS

Shea, K.A**,** Sellers, T.P, Brodhead, M.T., Kipfmiller, K.J., Sipila-Thomas, E.S. (2019) A review of mand frame training procedures for individuals with autism. European Journal of Behavior Analysis, DOI: 10.1080/15021149.2019.1661708

APPOINTMENTS

2015-2019 **Graduate Research Assistantship**
Dept. of Special Education, Utah State University
Supervisor: Dr. Tyra Sellers and Dr. Sarah Pinkelman

2013-2014 **Graduate Research Assistantship**
Dept. Communicative Disorders, Utah State University
Supervisor: Dr. Lauri Nelson

2010-2012 **Graduate Research Assistantship**
Dept. of Special Education, Utah State University
Supervisor: Dr. Lillian Durán

EDITORIAL EXPERIENCE

Journal of Applied Behavior Analysis	Guest Reviewer, 2017-present
Behavior Analysis in Practice	Guest Reviewer, 2017-present

PUBLICATIONS

Shea, K., Sellers, T. P., Brodhead, M. T., Kipfmiller, K. J., & Sipila-Thomas, E. S. (2019). A review of mand frame training procedures for individuals with autism. *European Journal of Behavior Analysis*, 1-14.

MENTORSHIP EXPERIENCES

BCBA Supervision (2015-present)

- Provided mentorship to master's students preparing to sit for the BCBA exam.

Thesis Supervision (2016-present)

- Provided mentorship to master's students as they prepared to run studies to fulfill requirements of their M.S. degree in Applied Behavior Analysis

TEACHING EXPERIENCES

TEACHING

Undergraduate

- SPED 5050: Applied Behavior Analysis 2: Applications (2018)

TEACHING ASSSISTANT

Undergraduate

- SPED 5050: Applied Behavior Analysis 2: Applications (2016, 2017)

Graduate

- SPED 6700: Introduction to Educational and Behavioral Research (2015)
- SPED 6750: Supervised Practicum in Applied Behavior Analysis (2016-present)

CONFERENCE PRESENTATIONS

Shea, K.A, Sellers, T.P, Walker, S.G. (2019) Interactive Computer Training for Graphing Embedded Phase Change Lines in Microsoft Excel. Annual Behavior Analysis International Conference, Chicago, IL.

Shea, K.A, Sellers, T.P, Walker, S.G. (2019) Interactive Computer Training for Graphing Embedded Phase Change Lines in Microsoft Excel. Utah State University Student Research Week, Logan, UT.

Shea, K.A., Walker, S.G. (2018) Visual Analysis of Data. Utah Association for Behavior Analysis Conference, Salt Lake City, UT.

Sellers, T.P., **Shea, K.A.,** Walker, S. (2018) Critical Components of Effective and Ethical Supervisory Practices. Four Corners Association for Behavior Analysis Conference. Park City, UT.

Shea, K.A. (2018) ABC's of Everyday Behavior. UVU Autism Conference, Orem, UT.

Shea, K.A., Walker, S.G., (2017) How to create process maps to enhance process performance within your organization. Utah Association for Behavior Analysis Conference, Salt Lake City, UT.

Shea, K.A, Corralejo, S.M., Lee, J.A, Sellers, T.P., (2016) Evaluation of Implementation Language on Functional Analysis Outcomes. Annual Behavior Analysis International Conference, Denver, CO.

Shea, K.A, Paskins, R, (2017) ABC's of Everyday Behavior. Utah Multi-Tiered Systems of Support Annual Conference, Layton, UT.

Shea, K.A, Lee, J.A, (2016) Treatment Selection for Challenging Behavior. Utah Multi-Tiered Systems of Support Annual Conference, Layton, UT.

WORKSHOP PRESENTATIONS

Shea, K.A, (2019). How to Make Treatment Fidelity Happen for Every Behavior Plan. Utah Professional Development Network Training. Taylorsville, UT.

Shea, K.A., Walker, S., (2018)**.** How to create process maps to enhance process performance within your organization. A live-webinar delivered to members of the Utah Association for Behavior Analysts.

Sellers, T.P., Shea, K.A., Walker, S., (2018). Utah Professional Development Network Behavior Bootcamp. Week long workshop presented to school district personnel.

Shea, K.A, (2017). Behavior Intervention Plans in Schools. Training delivered to Tooele School District. Tooele, UT.

Sellers, T.P., Shea, K.A., (2016). Treatment Selection and Intervention Planning. Utah Professional Development Network Event. Salt Lake City, UT.

Hoffmann, A.D., Bogoev, B.A., Shea, K.A., (2016). How to Conduct Trial-Based Functional Analyses. Workshop presented to behavior analysts in Utah. Logan, UT.

POSTER PRESENTATIONS

Shea, K.A., Corralejo, S.M., Sellers, T.P., Lee, J.T (2016). Evaluation of Implementation Language on Functional Analysis Outcomes. Poster presented at the Annual Graduate Research Week, Logan, UT.

Hoffmann, A.D., Sellers, T.P., Bogoev, B.A., **Shea, K.A.,** (2016). Telehealth Functional Analysis and Functional Communication Training for Families Receiving Part C Early Intervention. Poster presented at the Annual Utah Association for Behavior Analysis Conference, Provo, UT.

GRANT FUNDING

Student Travel Funding Grant (2019) to present in a research presentation at the Annual Behavior Analysis International Conference, Chicago, IL.

Student Travel Funding Grant (2017) to present in a research presentation at the Annual Behavior Analysis International Conference, Denver, CO.