

THE EFFECTS OF THERAPIST-MEDIATED SIGNALS AND PARTICIPANT-MEDIATED
RESPONSES ON THE DELAY TOLERANCE OF TYPICALLY DEVELOPING
PRESCHOOL CHILDREN

BY

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Abstract

The purpose of the current study was to compare the effects of providing a brief versus a continuous signal during delays to reinforcement on preschool children's tolerance of delays and to assess whether children's delay tolerance was differentially affected by caregiver-mediated or child-mediated signals to delay. Three typically developing preschool children who demonstrated sensitivity to magnitude of reinforcement and no tolerance of 5-min delays to reinforcement participated in the current study. Results suggest that brief and continuous caregiver signals, as well as brief participant responses were not effective for enhancing delay tolerance. However, continuous participant responses enhanced delay tolerance for all three participants. That is, providing participants with preferred leisure items during delays to reinforcement increased participants' choice of large, delayed reinforcers.

The Effects of Therapist-Mediated Signals and Participant-Mediated Responses on the Delay Tolerance of Typically Developing Preschool Children

Some young children have difficulty waiting for things they want (i.e., tolerating delays); however, there are several reasons why waiting (and teaching waiting) might be important. One reason why waiting might be important is that waiting sometimes involves gaining access to more preferred items, activities, and interactions (Hanley, Heal, Tiger, & Ingvarsson, 2007; Mischel, Ebbesen, & Zeiss, 1972; Schweitzer & Sulzer-Azaroff, 1988). For example, children may gain immediate but brief access to preferred toys by taking them from another child (i.e., toy stealing), whereas they may gain delayed but extended access to preferred toys by waiting for their turn. Toy stealing may result in brief access to toys because caregivers are likely to remove the stolen toys and give them back to the child from whom they were stolen. Alternatively, waiting for one's turn (i.e., for the other child to share) may result in extended access to toys because they are not likely to be taken away by the caregiver.

Another reason why waiting might be important is that children often encounter situations throughout the day in which they cannot have immediate access to what they want. For example, a child may need to wait for a teacher's attention because the teacher is talking to another individual, or the child may need to wait to play with their favorite toy because a peer is currently playing with it. It is possible that these common situations might evoke problem behavior (e.g., inappropriate vocalizations, toy stealing, aggression, or property destruction); therefore, waiting is likely to be an appropriate replacement behavior. Hanley et al. (2007) demonstrated that prior to being taught delay tolerance, children in a preschool classroom rarely waited appropriately when instructed and sometimes engaged in problem behavior. However, after being taught to tolerate delays to reinforcement, all children engaged in higher levels of

appropriate waiting and lower levels of problem behavior. These data suggest that waiting does function as an appropriate replacement behavior during delays to reinforcement. Finally, research has shown that children's ability to wait (i.e., display delay tolerance) is correlated with their academic, social, and coping skills as adolescents (Mischel, Shoda, & Peake, 1988; Mischel, Shoda, & Rodriguez, 1992), which suggests that teaching children to tolerate delays may result in better academic, social, and coping skills later in their life.

In basic and applied research, a few procedures have been evaluated to enhance delay tolerance (i.e., increase the amount of time a subject will wait for preferred items). One method that has been shown to enhance delay tolerance is delay fading (i.e., gradually increasing the amount of time the subject is required to wait; Ferster, 1953; Fisher, Thompson, Hagopian, Bowman, & Krug, 2000; Logue & Pena-Correal, 1984; Logue, Rodriguez, Pena-Correal, & Mauro, 1984; Neef, Bicard, & Endo, 2001; Schweitzer & Sulzer-Azaroff, 1988). For example, Schweitzer and Sulzer-Azaroff (1988) assessed children's delay tolerance in the absence of intervention and found that children did not tolerate delays to reinforcement (i.e., children consistently chose a small, immediate reinforcer over a large, delayed reinforcer). Subsequently, Schweitzer and Sulzer-Azaroff implemented delay fading by presenting children with a small, immediate reinforcer and large, immediate reinforcer and then gradually increasing the delay to the large reinforcer. That is, once a child was consistently choosing the large reinforcer, the delay to the large reinforcer was increased by 5-s increments. Following delay fading, four of the five children tolerated delays that were at least 35 s longer than the delays they tolerated during baseline.

Although gradually increasing the delay to reinforcement has been shown to enhance delay tolerance on its own, it has also been shown to be effective when combined with other

procedures such as providing an alternative activity during the delay (Binder, Dixon, & Ghezzi, 2000; Dixon & Cummings, 2001; Dixon & Falcomata, 2004; Dixon, Hayes, Binder, Manthey, Sigman, & Zdanowski, 1998; Dixon & Holcomb, 2000; Dixon, Rehfeldt, & Randich, 2003; Dixon & Tibbetts, 2009) or presenting signals during the delay (Grey, Healy, Leader, & Hayes, 2009; Vollmer, Borrero, Lalli, & Daniel, 1999). For example, Vollmer et al. (1999) demonstrated that, for two young boys with developmental disabilities who engaged in severe problem behavior, providing a continuous signal (e.g., a countdown timer) during delays to reinforcement (10 s for one participant and a gradual increase from 10 s to 10 min for the other) enhanced delay tolerance. That is, delays involving a continuous signal resulted in subjects consistently choosing the large, delayed reinforcer more often; whereas, delays involving no signal resulted in participants choosing the smaller, immediate reinforcer more often. Similarly, Grey et al. (2009) demonstrated that delay fading and presenting a countdown timer during the delay to reinforcement enhanced delay tolerance for a young girl with developmental disabilities who engaged in problem behavior. Together, these results suggest that providing a continuous signal during delays to reinforcement might be effective as a means of increasing delay tolerance; however, it is unclear whether the signals had an effect on delay tolerance above and beyond that of delay fading.

Although the above-mentioned studies have suggested the possible effectiveness of continuous signals for enhancing delay tolerance, Vollmer et al. (1999) pointed out that continuous signals such as a countdown timer or other extraneous signals are not likely to be stimuli that are typically associated with delays to reinforcement in an individual's daily environment. Therefore, these continuous signals may result in less generalization and/or acceptability by caregivers. A more typical, and possibly more acceptable, means of signaling

delayed reinforcement might be to provide a brief signal during the delay (e.g., saying “wait”; Vollmer et al.). Research has demonstrated that pigeons’ responding for delayed reinforcement can be maintained by providing a brief signal during the delay period (Schaal & Branch, 1988; Schaal, Schuh, & Branch, 1992); however, there has been little research on the efficacy of brief signals for enhancing delay tolerance in humans.

Another method that has been shown to enhance delay tolerance is to provide the subject with something to do during the delay period (Anderson, 1978; Antrop, Stock, Verte, Wiersema, Baeyens, & Roeyers, 2006; Corfield, Al-Issa, & Johnson, 1976; Grosch & Neuringer, 1981; Hanley et al., 2007; Metzner, 1963; Mischel et al. 1972; Toner, Lewis, & Gribble, 1979; Toner & Smith, 1977). For example, (a) providing access to toys, (b) prompting children to think about something fun (e.g., “you can think about playing with toys”), and (c) providing children something to say during the delay period have all been shown to increase the length of time that children wait for a reinforcer (Anderson, 1978; Hanley et al., 2007; Mischel et al., 1972; Toner & Smith, 1977).

Mischel et al. (1972) demonstrated that when preschool children were given the option of waiting for a large reinforcer or choosing to stop waiting and have a small reinforcer, children waited longer for the large reinforcer if there were toys available during the delay or they were instructed to think fun thoughts during the delay. In addition, they found that children who were instructed to think fun thoughts waited longer for the large reinforcer than children who played with toys. Similarly, Anderson (1978) found that children waited longer for the large reinforcer when there were toys available during the delay or when they were given something to say during the delay. Unlike Mischel et al., Anderson found that children who had toys available waited longer for the large reinforcer than children who were instructed to say something.

Toner and Smith (1977) also found that giving preschool children something to say during delays to reinforcement increased how long children waited. More specifically, children waited longer for delayed reinforcers when instructed to engage in vocalizations that were not related to the reward (e.g., “It is good if I wait” or counting “one, two, three, etc.”) than children who were not instructed to engage in vocalizations or instructed to engage in vocalizations related to the reward (e.g., “The candy will taste good”). Hanley et al. (2007) extended previous research in two ways. First, they demonstrated that a group of children in a preschool classroom (as compared to children in a more controlled setting) could be taught to engage in vocalizations (i.e., “When I wait, I get what I want”) during delays to reinforcement, which increased delay tolerance. Second, they demonstrated that teaching children to engage in vocalizations during delays to reinforcement could be effective for decreasing problem behavior during delays imposed by both teachers *and* peers.

The research on delay tolerance suggests that children can be taught to tolerate delays to reinforcement by providing the child with something to do during the delay period or signaling the delay period; however, it is unclear whether brief signals (e.g., “wait”) are effective and if so, whether they are as effective as continuous signals (e.g., countdown timer). The purpose of the current study was to compare the effects of providing a brief versus a continuous signal during delays to reinforcement on preschool children’s ability to tolerate delays and to assess whether children’s delay tolerance was differentially affected by caregiver-mediated or child-mediated signals to delay.

General Method

Participants and Setting

Participants in this study were three typically developing preschool children (Larry, Nancy, and Amanda). Participants ranged in age from 3 to 5 years of age. All had age-appropriate language skills and could follow multi-step instructions. Inclusion criteria for participation involved (a) sensitivity to magnitude of reinforcement in which the participant consistently chose a large, immediate reinforcer over a small, immediate reinforcer (see reinforcer-magnitude assessment below) and (b) the inability to wait (either 2 min or 5 min) for preferred items in the absence of any intervention (see no-signal assessment below). Sessions were 15-30 min in length and were conducted in a session room containing a table, chairs, and relevant session materials (e.g., preferred foods, preferred leisure items, and a colored poster board). Sessions were conducted one to two times per day, three to five days per week and were separated by at least 30 minutes.

Preference Assessments

Prior to the first session, a paired stimulus preference assessment (Fisher et al., 1992) was conducted to identify highly preferred edible items for each participant. The stimuli were ranked based on the percentage of trials for which each item was chosen. Prior to each session, participants chose which of their three highest preferred edible items they wanted to use during that session. Prior to the beginning of Phase 4 (Participant-Mediated Response Assessment), participants were brought to a toy room and were allowed to choose their four favorite leisure items. These items were available to participants during particular sessions in Phases 4 and 5.

Response Measurement and Interobserver Agreement

The dependent variables were large-, small-, no-, and leisure-reinforcer choice. All dependent variables were scored using a frequency measure. *Large-reinforcer choice* was defined as the participant choosing (touching) the plate containing four pieces of the preferred

edible. *Small-reinforcer choice* was defined as the participant choosing (touching) the plate containing one piece of the preferred edible. *No-reinforcer choice* was defined as the participant choosing (touching) the plate containing no edibles. *Leisure-reinforcer choice* was defined as the participant choosing (touching) the leisure items.

Data were also collected on the independent variables (i.e., brief and continuous signals and responses) and additional therapist behavior (i.e., prompts and stimulus delivery). *Brief signals* were defined as the therapist saying, “When you wait, you get four pieces” and were scored using a frequency measure. *Continuous signals* were defined as the therapist starting the countdown timer and placing it in front of the participant and were scored using a frequency measure. *Brief responses* were defined as the participant saying, “When I wait, I get four pieces” and were scored using a frequency measure. *Continuous responses* were defined as the participant engaging with the preferred items/activities, available following large-reinforcer choices, and were scored using partial interval recording with 10-s intervals. *Prompts* were defined as the therapist saying “Pick the one you want.” *Stimulus delivery* was defined as the therapist providing the participant with an empty plate (no-reinforcer delivery), a plate with one edible item (small-reinforcer delivery), a plate with four edible items (large-reinforcer delivery), or the leisure items (leisure-reinforcer delivery).

Trained observers recorded participant behavior (choice selection and brief or continuous responses) and therapist behavior (signals, prompts, and stimulus deliveries) on hand-held computers. Interobserver agreement was assessed by having a second observer simultaneously but independently record participant and therapist behavior during at least 30% of sessions across participants. Interobserver agreement (IOA) for the dependent variables was calculated using a total agreement method in which the smaller number recorded by one observer was

divided by the larger number recorded by the other observer and these quotients were then multiplied by 100% to obtain a percentage agreement. Mean agreement was 93% (range, 0% to 100%) for large-reinforcer choices, 99% (range, 50% to 100%) for small-reinforcer choices, 99% (range, 0% to 100%) for no-reinforcer choices, and 92% (range, 80% to 100%). While IOA averages were high, the ranges suggest that IOA percentages were low for some sessions. These low percentages were because of the few number of choice trials and low levels of choice of a particular stimulus. For example, if a participant chose a particular stimulus once, and one observer scored it and the other observer did not score it, the resulting percentage of agreement would be 0%.

Interobserver agreement for all other behaviors (i.e., signals, responses, prompts, and stimulus deliveries) was calculated by first dividing sessions into 10-s intervals and then determining proportional agreement, which was calculated by dividing the smaller number of responses (scored by one observer) within an interval by the larger number (scored by the other observer) in that same interval. These fractions were summed, divided by the total number of intervals, then multiplied by 100% to obtain a percentage agreement for the session. Mean agreement across participants was 99% (range, 98% to 100%) for brief signals, 99% (range, 99% to 100%) for continuous signals, 99% (range, 99% to 100%) for brief responses, 96% (range, 87% to 100%) for continuous responses, 97% (range, 91% to 100%) for prompts, 99% (range, 95% to 100%) for no-reinforcer delivery, 99% (range 93% to 100%) for small-reinforcer delivery, 99% (range 92% to 100%) for large-reinforcer delivery, and 99% (range, 96% to 100%) for leisure-reinforcer delivery.

Experimental Design

A concurrent-operant arrangement was used in all phases to evaluate the number

of choices to each of three stimuli available. A multielement design was used in Phases 2-4 to compare the effects of different interventions for increasing delay tolerance. In addition, for one participant (Larry), a reversal design was used to show replication of the effects of the effective intervention. The order in which participants experienced Phases 3 and 4 was counterbalanced to control for order effects. Larry experienced Phase 4 first, and Nancy and Amanda experienced Phase 3 first.

Phase 1: Reinforcer-Magnitude Assessment

The purpose of this phase was to determine whether participant behavior was sensitive to reinforcer magnitude (and was one of the inclusion criterion for participation in the study). That is, whether the participant would choose four edible items (large magnitude) over one edible item (small magnitude) when both were available immediately. Participants that consistently chose the large magnitude over the small magnitude met the first inclusion criterion for participation and moved on to Phase 2 of the study.

Procedure

Sessions consisted of five trials in which the participant was given the opportunity to choose one of three plates. One plate contained one edible item, a second plate contained four edible items, and a third plate contained no edible items. At the start of all sessions, the participant was told the contingencies in place for that session (i.e., “If you pick the empty plate you will not get any X; if you pick the plate with one piece, you will get one piece of X right away; and if you pick the plate with four pieces, you will get four pieces of X right away”). In addition, the participant was given pre-session exposure to the contingencies for choosing each plate. That is, the participant was prompted to choose each of the three plates, and the

contingencies associated with each plate were implemented after the choice (i.e., eating nothing, one piece, or four pieces).

At the start of each trial, the therapist presented the three plates containing the various stimuli and provided the prompt “Pick the one you want.” After the participant made his or her choice (by pointing to a plate), the therapist gave the participant the chosen plate. Once the participant consumed the edible item(s) or was given brief (i.e., 1-3 s) access to the empty plate, a new trial began. The placement of the plates (i.e., left, center, or right) was alternated during all trials, with no plate being placed in the same position for more than two consecutive trials. This phase was conducted until the participant chose the large reinforcer on 100% of trials for at least three consecutive sessions.

Phase 2: No-Signal Assessment

The purpose of this phase was to compare participants’ choices between a small, immediate reinforcer and a large, delayed reinforcer (with and without the presence of the reinforcer) when the delay to the large reinforcer was not signaled. The effect of reinforcer presence/absence was assessed because previous researchers have demonstrated that subjects may wait longer when reinforcers are absent as compared to present during delays to reinforcement (Grosch & Neuringer, 1981; Mischell & Ebbesen, 1970). Participants that did not consistently choose the large, delayed (2- or 5-min delay) reinforcer over the small, immediate reinforcer met the second inclusion criterion for participation and moved on to Phases 3 and 4 of the study.

Procedure

Sessions were similar to those in Phase 1, except the contingency associated with the large reinforcer (four edible items) was different. That is, choosing the plate containing the

small reinforcer (one edible item) or the empty plate (no edibles) resulted in immediate delivery of the chosen plate; however, choosing the plate containing the large reinforcer resulted in a delay to delivery of the plate. Because there was a delay associated with one of the stimuli, an inter-choice interval (i.e., a period of time between the choice of a plate and the beginning of the next trial; ICI) was utilized to hold trial length constant and to ensure that the child could not complete a session earlier by choosing the small, immediate reinforcer. The ICI across all sessions (and regardless of child choice) was the delay period for that session + 1 min. For example, if the delay period for choosing the large reinforcer was 2 min, then when a child chose the small- or no-reinforcer plate, the plate was delivered and 3 min (2 min + 1 min) elapsed before the next trial. However, if the child chose the large-reinforcer plate, the delay period (2 min) elapsed, the plate was delivered, and then a 1 min period of time also elapsed before the next trial. We chose to calculate the ICI by adding 1 min to the delay because participants were typically able to consume the large reinforcer in one minute or less.

Throughout all sessions, the therapist provided minimal attention to participants. This was done because pilot data suggested that participants would wait for the large, delayed reinforcer when the therapist continuously interacted with them throughout sessions. Because the therapist did not interact with participants during sessions, two low preference items (as determined by a previous paired stimulus preference assessment) were available throughout all sessions.

No signal (food present). Sessions were similar to those conducted during Phase 1; however, choosing the plate with four edible items resulted in the therapist removing the two plates that were not chosen while the plate containing the four edible items remained in view. After a delay (wait period) of 2 min, the therapist delivered the plate containing the four edible

items to the participant. If a participant consistently chose the plate with four edible items when the delay was 2 min, the delay was increased to 5 min. If a participant consistently chose the plate containing four edible items when the delay was 5 min, he or she was not included in the study because he or she waited in the absence of intervention. However, if the participant consistently chose the plate containing one edible item when the delay was 2 min or 5 min, he or she met the second criterion for inclusion in the study and moved on to Phase 3 or Phase 4.

No signal (food absent). Sessions were similar to no-signal (food present) sessions; however, following a choice of the plate containing four edible items (and associated with delayed reinforcement), the therapist removed all plates. After the delay (wait period of either 2 min or 5 min, depending on the phase), the therapist delivered the plate containing the four edible items to the participant.

Phase 3: Therapist-Mediated Signal Assessment

The purpose of this phase was to compare participants' choices between a small, immediate reinforcer and a large, delayed reinforcer when the therapist provided either a brief or continuous signal during the delay. In order to enhance discrimination of the different session types, a poster board (whose color was correlated with session type) was present on the table. A white poster board was present during no-signal sessions, a blue poster board was present during brief-signal sessions, and a yellow poster board was present during continuous-signal sessions.

Procedure

Sessions were similar to those in Phase 2 with a few exceptions. First, all sessions were similar to the no-signal (food present) sessions from Phase 2 because (a) all participants made similar choices across food-present and food-absent sessions and (b) previous researchers have demonstrated that subjects may have greater difficulty tolerating delays when reinforcers are

present as compared to absent during the delay (Grosch & Neuringer, 1981; Mischell & Ebbesen, 1970). Second, during some sessions, signals (either brief or continuous) were provided by a therapist when the participant chose the large, delayed reinforcer. Third, as in Phase 2, the ICI was the delay period + 1 min. However, because a 5-min delay was used with all participants in all sessions, the ICI was 6 min (i.e., 5-min delay + 1 min).

No signal. Sessions were identical to no-signal (food present) sessions from Phase 2.

Brief signal. These sessions were similar to no-signal sessions except, when the participant made a choice, the therapist gave a verbal description of what the child would receive. If the participant chose the empty plate, the therapist said, “You get none,” while delivering the empty plate. If the participant chose the plate with one edible item, the therapist said, “You get one piece now,” while delivering the plate containing one piece. If the participant chose the plate with four edible items, the therapist said, “When you wait, you get four pieces.” After the delay, the therapist provided the plate containing four pieces.

Continuous signal. These sessions were similar to brief-signal sessions in that no-reinforcer and small-reinforcer choices resulted in identical consequences. However, unlike brief-signal sessions, when the participant chose the plate containing four edible items, the therapist said, “When you wait, you get four pieces” *and* a countdown timer was started and placed in front of the participant during the delay period. To promote discrimination between continuous- and brief-signal sessions, the timer was placed next to the plate containing four edible items during choice trials.

Phase 4: Participant-Mediated Response Assessment

The purpose of this phase was to compare participants’ choices between a small, immediate reinforcer and a large, delayed reinforcer when the participant engaged in either a

brief or continuous response during the delay to the large reinforcer. In order to enhance discrimination between the different sessions, a white poster board was present during no-response sessions, a blue poster board was present during brief-response sessions, and a yellow poster board was present during continuous-response sessions.

Procedure

Sessions were similar to those in Phase 3, except that during some sessions, participants were required to engage in particular responses (either a brief or continuous response) when he or she chose the large, delayed reinforcer.

No response. Sessions were identical to no-signal sessions in Phase 3.

Brief response. These sessions were similar to no-response sessions; however, the participant engaged in a brief response when he or she chose the plate containing four edibles. That is, when the participant chose the plate containing four edibles, he or she said, “When I wait, I get four pieces,” and the therapist provided the four edibles after the programmed delay elapsed. Participants were taught to engage in the brief response prior to the start of the first brief-response session. That is, during the pre-session rules of the first brief-response session, participants were prompted through engaging in the brief response following choice of the plate containing four edible items. Additionally, participants were prompted to practice this response until they were able to engage in the response independently. During all subsequent sessions, if participants did not independently engage in the brief response during the forced exposure to the plate containing four edible items, he or she was prompted to practice the response until they were able say it independently when they chose the plate with four edible items. On all trials, if the participant did not engage in the brief response following a choice of the plate containing

four edibles, the therapist provided the least intrusive prompt necessary to evoke the brief response (e.g., glancing at the participant expectantly or saying “Wh...”).

Continuous response. These sessions were similar to brief-response sessions. However, when the participant chose the plate containing four edibles, he or she said, “When I wait, I get four pieces,” *and* highly preferred leisure items were available during the delay period. After the delay elapsed, the therapist removed the leisure items and provided the four edible items. In order to enhance discrimination between brief- and continuous-response sessions, the highly preferred leisure items were placed behind the plate containing four edible items during choice trials. As in brief-response sessions, participants were taught to engage in the vocal statement prior to the start of the first session and during sessions the therapist provided the least intrusive prompt necessary to evoke the vocal statement when participants did not independently emit the vocal statement.

Phase 5: Edible vs. Leisure Assessment

During Phase 4, the highly preferred leisure items were only available following large, delayed reinforcer choices in continuous-response sessions. Given this, it is possible that participants preferred the leisure items more than the large, delayed reinforcer and therefore only chose the large, delayed reinforcer to access the leisure items. The purpose of this phase was to evaluate whether the highly preferred leisure items, available during continuous-response sessions, were more preferred than the four edible items when both were available immediately.

Procedure

Sessions were similar to those in Phase 1; however, the stimuli available during each trial were an empty plate, a plate with four edible items, and the highly preferred leisure items. At the

start of all sessions, the participant was told the contingencies in place for that session and was given pre-session exposure to the contingencies for choosing each of the stimuli.

Sessions included five trials, in which the participant was given the opportunity to choose the empty plate, the plate containing four edible items, or the highly preferred leisure items. Because when participants chose the highly preferred leisure items they were given 5-min access to them, an ICI (i.e., a period of time between the choice of a stimulus and the beginning of the next trial) was utilized to hold trial length constant and to ensure that the child could not complete a session earlier by choosing the food. The ICI was calculated by adding 1 min to the leisure item access period. We chose to calculate the ICI by adding 1 min to the leisure item access period to keep the ICI the same as in previous phases.

At the start of each trial, the therapist provided the prompt “Pick the one you want.” If the participant chose the plate with no edible items, the therapist provided the empty plate and removed all other plates/leisure items for the remainder of the ICI. If the participant chose the plate containing four edible items, the therapist provided the four edible items immediately and removed all other plates/leisure items for the remainder of the ICI. If the participant chose the highly preferred leisure items, the therapist removed the plates of edibles and provided access to the leisure items for 5 min. At the end of the 5 min, the leisure items were removed for the remainder of the ICI (i.e., for 1 min).

Results

Figure 1 shows the results of the edible-item paired-stimulus preference assessments for all three participants with edible items listed along the abscissa and percentage of item choices listed along the ordinate. Larry’s top three preferred edible items were marshmallows (chosen 100% of trials), sour gummies (chosen 67% of trials), and chocolate (chosen 56% of trials).

Nancy's top three preferred edible items were nacho chips (chosen 100% of trials), fish crackers (chosen 89% of trials), and sour gummies (chosen 78% of trials). Amanda's top three preferred edible items were cookies (chosen 89% of trials), sour candy (chosen 67% of trials), and nacho chips (chosen 67% of trials).

Data from the reinforcer-magnitude assessment, no-signal assessment, therapist-signal assessment, and participant-response assessment are presented in the top three panels of Figures 2, 3, and 4 for Larry, Nancy, and Amanda, respectively. For all three figures, sessions are listed along the abscissa and frequency of large-reinforcer choices, small-reinforcer choices, and no reinforcer choices are listed along the ordinate in the first, second, and third panel respectively. All participants chose the no reinforcer (control) option very infrequently; therefore the data will be discussed in terms of large- and small-reinforcer choices with a focus on large-reinforcer choices (the first panel).

As shown in Figure 2, during Phase 1 (Reinforcer-Magnitude Assessment) we evaluated whether Larry's choice behavior was sensitive to magnitude of reinforcement. During these sessions, Larry chose the large reinforcer on all trials except the first two trials of the first session. That is, Larry's choice behavior was sensitive to magnitude of reinforcement.

During Phase 2 (No-Signal Assessment), we evaluated whether Larry would continue to choose the large reinforcer when there was a delay and the food was either present or absent during the delay. In no-signal (2-min) delay sessions, Larry consistently chose the large, delayed reinforcer across reinforcer-present and -absent sessions suggesting that he was able to wait 2 min in the absence of any intervention. Thus, the delay to the large reinforcer was increased to 5 min. During no-signal (5-min) delay sessions, Larry began choosing the small, immediate reinforcer more often than the large, delayed reinforcer suggesting that he was not able to wait 5

min in the absence of any intervention. To ensure that the decrease in Larry's choice of the large, delayed reinforcer was not due to a decrease in sensitivity to magnitude of reinforcement we conducted a reinforcer-magnitude assessment probe at session 21 (this session was identical to sessions during Phase 1). During the probe he chose the large, immediate reinforcer four times suggesting that his choice behavior was still sensitive to magnitude of reinforcement.

Because we counterbalanced the order of Phases 3 and 4, Larry experienced Phase 4 prior to experiencing Phase 3. During Phase 4 (Participant-Mediated Response Assessment), we evaluated the effects of having Larry engage in brief and continuous responses during the delay to the large reinforcer. In continuous-response sessions, Larry began consistently choosing the large-delayed reinforcer; whereas, in brief- and no-responses sessions, he intermittently chose the large-delayed reinforcer. These data suggest that continuous responses were effective for enhancing Larry's delay tolerance, whereas brief responses were not.

During Phase 3 (Therapist-Mediated Signal Assessment), we evaluated the effects of the therapist providing a brief- or continuous-signal during the delay to the large reinforcer. As shown in Figure 2, neither the brief- nor the continuous-signals increased Larry's choice of the large-delayed reinforcer relative to no-signal sessions suggesting that brief and continuous signals were not effective for enhancing Larry's delay tolerance. During this phase we conducted three reinforcer-magnitude assessment probes at sessions 43, 50, and 51 to ensure that the decrease in Larry's choice of the large, delayed reinforcer was not due to a decrease in sensitivity to magnitude of reinforcement. During session 43 he chose the large, immediate reinforcer four times suggesting that his choice behavior was still sensitive to magnitude of reinforcement. However, during sessions 50 and 51 he only chose the large, immediate reinforcer three times suggesting that either his choice behavior was no longer sensitive to magnitude of reinforcement

or something about the therapist signals (e.g., watching a timer) made choice of the large reward aversive.

To ensure that we could recapture choice of the large reward and replicate the effects of the participant-mediated continuous response, we reversed back to Phase 4. During the reversal, Larry again consistently chose the large-delayed reinforcer in continuous-response sessions and consistently chose the small-immediate reinforcer in brief- and no-response sessions. Because of the decrease in large, immediate reinforcer choices during reinforcer-magnitude assessment probes in Phase 3, we conducted reinforcer-magnitude assessment probes from session 64 to 68 during the reversal. In sessions 64 to 66 Larry chose the large, immediate reinforcer 3 times per session; however, in sessions 67 and 68 large, immediate reinforcer choice increased to 4 times per session suggesting that his choice behavior was sensitive to magnitude of reinforcement. We ran several reinforcer-magnitude assessment probes during this phase because we hypothesized that the pairing of leisure items with the large reinforcer during participant-mediated continuous-response sessions may have made the large reinforcer less valuable when presented in the absence of leisure items. Therefore, we hypothesized that repeated presentations of the large reinforcer in the absence of the leisure items would restore the value of the large reinforcer, and the data appear to support this hypothesis.

Based on the data from Phase 4, it was unclear whether Larry was choosing the large, delayed reinforcer during participant-mediated continuous-response sessions because he preferred the leisure items that were available more than the food. Therefore, we decided to evaluate his preference for the leisure items and the food during Phase 5 (Food vs. Leisure Assessment). As shown in the bottom panel of Figure 2, during three of the seven sessions, Larry chose the leisure items between four and five times; however, during the other four sessions his

responding was indifferent (i.e., he chose the leisure items and food equally as often). Thus, Larry's pattern of responding suggests that it is unlikely that exclusive responding for the large, delayed reinforcer in the participant-mediated continuous-response sessions was due to the fact that the leisure items were more preferred than the food.

As shown in Figure 3, during Phase 1 (Reinforcer-Magnitude Assessment), we evaluated whether Nancy's choice behavior was sensitive to magnitude of reinforcement. During these sessions, Nancy chose the large reinforcer on all trials except for one (during the first and third sessions) suggesting that her choice behavior was sensitive to magnitude of reinforcement.

During Phase 2 (No-Signal Assessment), we evaluated whether Nancy would continue to choose the large reinforcer when there was a delay and the food was either present or absent during the delay. In no-signal (2-min) delay sessions, Nancy consistently chose the large, delayed reinforcer across reinforcer-present and -absent sessions suggesting that she was able to wait 2 min in the absence of any intervention. Therefore, the delay to the large reinforcer was increased to 5 min. During no-signal (5-min) delay sessions, Nancy began choosing the small, immediate reinforcer more often than the large, delayed reinforcer suggesting that she was not able to wait 5 min in the absence of any intervention. To ensure that the decrease in Nancy's choice of the large, delayed reinforcer was not due to a decrease in sensitivity to magnitude of reinforcement we conducted a reinforcer-magnitude assessment probe at sessions 16 and 17. During session 16 she only chose the large, immediate reinforcer three times suggesting that her sensitivity to magnitude may have decreased; however, during session 17 she chose the large, immediate reinforcer five times suggesting that her choice behavior was still sensitive to magnitude of reinforcement.

During Phase 3 (Therapist-Mediated Signal Assessment), we evaluated the effects of the

therapist providing a brief- or continuous-signal during the delay to the large reinforcer. As shown in Figure 3, neither the brief- nor the continuous-signals increased Nancy's choice of the large, delayed reinforcer relative to no-signal sessions suggesting that brief and continuous signals were not effective for enhancing Nancy's delay tolerance. At the end of this phase (session 31) we conducted a reinforcer-magnitude assessment probe to ensure that the decrease in Nancy's choice of the large, delayed reinforcer was not due to a decrease in sensitivity to magnitude of reinforcement. During the probe she chose the large, immediate reinforcer on all five trials suggesting that her choice behavior was still sensitive to magnitude of reinforcement.

During Phase 4 (Participant-Mediated Response Assessment), we evaluated the effects of having Nancy engage in brief and continuous responses during the delay to the large reinforcer. In continuous-response sessions, Nancy consistently chose the large, delayed reinforcer; whereas, in brief- and no-responses sessions, her choice of the large, delayed reinforcer decreased across sessions. These data suggest that continuous responses were effective for enhancing Nancy's delay tolerance, whereas brief responses were not.

Similar to Larry, it was unclear whether the reason Nancy was choosing the large, delayed reinforcer during participant-mediated continuous-response sessions was because she preferred the leisure items that were available more than the food. Therefore, we evaluate her preference for the leisure items and the food during Phase 5 (Food vs. Leisure Assessment). As shown in the bottom panel of Figure 3, Nancy chose the food four times during the first two sessions and five times during the third session. Therefore, based on Nancy's pattern of responding, it is unlikely that exclusive responding for the large, delayed reinforcer in the participant-mediated continuous-response sessions was due to the fact that the leisure items were more preferred than the food.

As shown in Figure 4, during Phase 1 (Reinforcer-Magnitude Assessment), we evaluated whether Amanda's choice behavior was sensitive to magnitude of reinforcement. During these sessions Amanda chose the large reinforcer on all trials, except for one trial in the first session. Thus, Amanda's choice behavior was sensitive to magnitude of reinforcement.

During Phase 2 (No-Signal Assessment), we evaluated whether Amanda would continue to choose the large reinforcer when there was a delay and the food was either present or absent during the delay. In no-signal (2-min) delay sessions, Amanda chose the large reinforcer intermittently at first; however, after repeated exposure to the contingencies, she began consistently choosing the large reinforcer during reinforcer-present and -absent sessions. That is, she was able to wait 2 min in the absence of any intervention. Therefore, the delay to the large reinforcer was increased to 5 min. During no-signal (5-min) delay sessions, Amanda frequently made three large, delayed reinforcer choices per session suggesting that she was only sometimes able to wait 5 min in the absence of any intervention. To ensure that Amanda's choice behavior continued to be sensitive to magnitude of reinforcement, we conducted a reinforcer-magnitude assessment probe during this and subsequent phases. During Phase 2, these probes occurred at sessions 26 and 51, and show that Amanda chose the large, immediate reinforcer on all five trials suggesting that her choice behavior was still sensitive to magnitude of reinforcement.

During Phase 3 (Therapist-Mediated Signal Assessment), we evaluated the effects of the therapist providing a brief- or continuous-signal during the delay to the large reinforcer. At the beginning of this phase, Amanda's choice of the large-delayed reinforcer increased across all sessions; however, over repeated exposure we observed decreases in her choice of the large, delayed reinforcer. That is, brief and continuous signals did not increase Amanda's choice of the large, delayed reinforcer relative to no-signal sessions suggesting that neither brief nor

continuous signals were effective for enhancing Amanda's delay tolerance. During this phase we conducted a reinforcer-magnitude assessment probe at sessions 77 and 90 to ensure that Amanda's choice behavior was still sensitive to magnitude of reinforcement. During both probes she chose the large, immediate reinforcer on all five trials suggesting that her choice behavior was still sensitive to magnitude of reinforcement.

During Phase 4 (Participant-Mediated Response Assessment), we evaluated the effects of having Amanda engage in brief and continuous responses during the delay to the large reinforcer. In continuous-response sessions, Amanda consistently chose the large, delayed reinforcer; whereas, in brief- and no-responses sessions, she consistently chose the small, immediate reinforcer. These data suggest that continuous responses were effective for enhancing Amanda's delay tolerance, whereas brief responses were not.

Similar to Larry and Nancy, it was unclear whether the reason Amanda was choosing the large, delayed reinforcer during participant-mediated continuous-response sessions was because she preferred the leisure items that were available more than the food. Therefore, we evaluate her preference for the leisure items and the food during Phase 5 (Food vs. Leisure Assessment). As shown in the bottom panel of Figure 4, during the second session Amanda chose the leisure items five times; however, during the other four sessions her responding was indifferent (i.e., she chose the leisure items and food approximately equally as often). Therefore, Amanda's pattern of responding suggests that it is unlikely that exclusive responding for the large, delayed reinforcer in the participant-mediated continuous-response sessions was due to the fact that the leisure items were more preferred than the food.

Discussion

The purpose of the present study was to evaluate the effects of brief and continuous

participant responses and brief and continuous caregiver signals on children's ability to tolerate delays to reinforcement. We found that participant-mediated continuous responses (i.e., playing with leisure items) were the only effective intervention for enhancing children's ability to tolerate delays to reinforcement. These results are consistent with previous research evaluating the effects of providing children with an alternative activity during delays to reinforcement (Anderson, 1978; Antrop et al., 2006; Corfield et al., 1976; Mischel et al., 1972).

Although our results are consistent with previous research on providing leisure items during delays to reinforcement, they are inconsistent with previous research evaluating the effects of providing children with something to say during the delay period (Anderson, 1978; Hanley et al., 2007; Mischel et al., 1972; Toner et al., 1979; Toner & Smith, 1977) and with previous research evaluating the effects of providing children a timer to watch during the delay period (Grey et al., 2009; Vollmer et al., 1999). We found that teaching children to say something during the delay to reinforcement did not enhance delay tolerance, whereas previous research has found the opposite effect (Anderson; Hanley et al.; Mischel et al.; Toner et al.; Toner & Smith). Anderson, Mischel et al., Toner et al., and Toner and Smith demonstrated that providing children with something to say while they were waiting for a delayed reward increased the amount of time that children would wait for the reward. Similarly, Hanley et al. found that teaching children to say something during a short fixed delay to reinforcement in their preschool classroom increased appropriate waiting.

One possible explanation for the disparity between the results of the current study and previous research is that different procedures were used with respect to the delay situation. In the current study, children chose between a small, immediate reinforcer and a large, delayed reinforcer. Once a choice was made on a given trial, the child was not able to change their

choice. Anderson (1978), Mischel et al. (1972), Toner et al. (1979), and Toner and Smith (1977) asked children to wait for a larger, delayed reward; however, while the children were waiting they could choose to have a smaller, immediate reward rather than continuing to wait for the delayed reward. A second possible explanation for the difference between the current study and previous research is that in previous studies children were instructed to repeat the vocalization during the delay period, whereas children in the current study were only instructed to engage in the vocalization once after choosing the delayed reinforcer. That is, in previous research, vocalizations were a continuous response (like playing with leisure items in the current study), whereas in the current study vocalizations were a brief response.

We used brief participant responses and brief caregiver signals in the current study based on the suggestion of Vollmer et al. (1999) that brief signals may be more akin to the signals provided in the natural environment. In addition to Vollmer et al.'s suggestion, some basic research has demonstrated that brief signals can maintain responding under delayed reinforcement (Schaal & Branch, 1988; Schaal, Schuh, & Branch, 1992). However, in those studies, as the delays to reinforcement increased, the efficacy of brief signals decreased. Schaal and colleagues suggested this may have been the case because as the delay increased, the brief signal was no longer paired contiguously with the terminal reinforcer. While previous research has not examined the effects of brief signals for humans, it seems likely that brief signals were not effective in the current study because they were used during relatively long delays (i.e., there was never any contiguity between the signal and the terminal reinforcer).

Similar to brief signals, continuous signals were not effective for increasing children's delay tolerance in the current study. Unlike the current study, Vollmer et al. (1999) and Grey et al. (2009) demonstrated that providing a continuous signal (e.g., countdown timer) during delays

to reinforcement enhanced children's delay tolerance. The difference between the results of the current study and previous findings may have occurred for a couple reasons. One reason that the current results may be different from previous studies is that the current study involved continuous signals during fixed delays to reinforcement, whereas previous research presented continuous signals during gradually increasing delays to reinforcement. That is, previous researchers started with a short delay, thus the continuous signal may have developed greater conditioned reinforcing strength because initially, it signaled a very short delay to the terminal reinforcer. Researchers might evaluate the reasons for the difference between the current study and previous research by comparing the effects of continuous signals during progressively increasing delays to reinforcement with continuous signals during a fixed delay to reinforcement.

Another potential explanation for the differences between the current study and previous research on continuous signals is that the current study included typically developing participants who did not engage in problem behavior, whereas previous research included participants with developmental disabilities who engaged in problem behavior and had limited vocal verbal repertoires. It may be the case that for individuals with a greater vocal verbal repertoire, the timer actually enhances sensitivity to delay because it shows just how long participants still have to wait.

Although the current study found similar results to previous research with respect to the effectiveness of leisure item availability during delays to reinforcement, the methods of the current study may have affected this outcome. In the current study, leisure items were only available following the choice of the delayed reinforcer; therefore, it is possible that the provision of leisure items did not actually enhance delay tolerance for the edibles, but resulted in participants choosing the delayed reinforcer because they preferred the leisure items over the

edibles. In order to evaluate this possibility, we assessed whether the leisure items provided during the delay to reinforcement were more preferred than the edible items and found that for one participant leisure items were more preferred, and for two participants leisure items and edible items were approximately equally preferred. Although these data suggest that participants were not choosing the delayed reward more often because leisure items were more preferred than the edible items for which they were waiting, a few possible explanations remain as to why providing leisure items during delays to reinforcement enhanced delay tolerance for those participants.

One possible explanation is that providing leisure items during delays to reinforcement mediates the delay to reinforcement (i.e., playing with leisure items while waiting decreases the aversiveness of waiting). Another possible explanation is that providing leisure items during delays to reinforcement did not affect delay tolerance. Rather, providing leisure items during delays to reinforcement decreased sensitivity to delay (i.e., playing with leisure items makes the delay [subjectively] feel shorter) or the reinforcing efficacy of leisure items and food was greater than food alone (i.e., there was an additive effect of having multiple reinforcers). Future researchers should evaluate why providing leisure items during delays to reinforcement increased choice of the large, delayed reinforcer. Once this has been determined, it should be evaluated whether teaching children to engage in alternative activities (e.g., playing with leisure items) during delays to reinforcement in the natural environment (e.g., a preschool classroom) enhances appropriate waiting and decreases problem behavior.

One limitation of the current study is that both participants and therapists engaged in the brief vocalizations during continuous sessions. While it is possible that engaging in the vocalizations during the continuous response (and signal) added to participants' ability to wait, it

seems unlikely given that brief responses (and signals) were completely ineffective when used by themselves. Additionally, previous researchers have paired vocalizations with continuous signals and have not suggested that this was a critical component of their treatment (Grey et al., 2009).

In summary, the current study demonstrated that providing children with leisure items to play with during delays to reinforcement increased children's choice of large, delayed reinforcers; whereas, giving children something to say or a timer to watch or telling children to wait did not increase choice of large, delayed reinforcers. The present study demonstrated that providing leisure items during delays to reinforcement increased choice of the large, delayed reinforcer for some reason other than the children simply preferred the leisure items more than the edibles for which they were waiting. However, it is still unclear why the leisure items increased children's choice of the large, delayed reinforcer. It is possible that playing with leisure items enhanced delay tolerance, decreased delay sensitivity, or that leisure items plus food is better than food alone. Regardless of why making leisure items available during delays to reinforcement increases delay tolerance, it is important to note that it *is* effective and therefore has clinical implications. For example, in order to increase delay tolerance (and possibly decrease the likelihood of problem behavior during delays to reinforcement) parents could choose a few of their child's highly preferred toys and only allow access to those toys when the child must wait for something he or she wants. Given the clinical implications of research on enhancing delay tolerance, future researchers should continue to examine the most effective means for enhancing children's delay tolerance. Additionally, they should examine why effective procedures for enhancing delay tolerance work. That is, they should examine the mechanism of action for effective procedures for enhancing delay tolerance.

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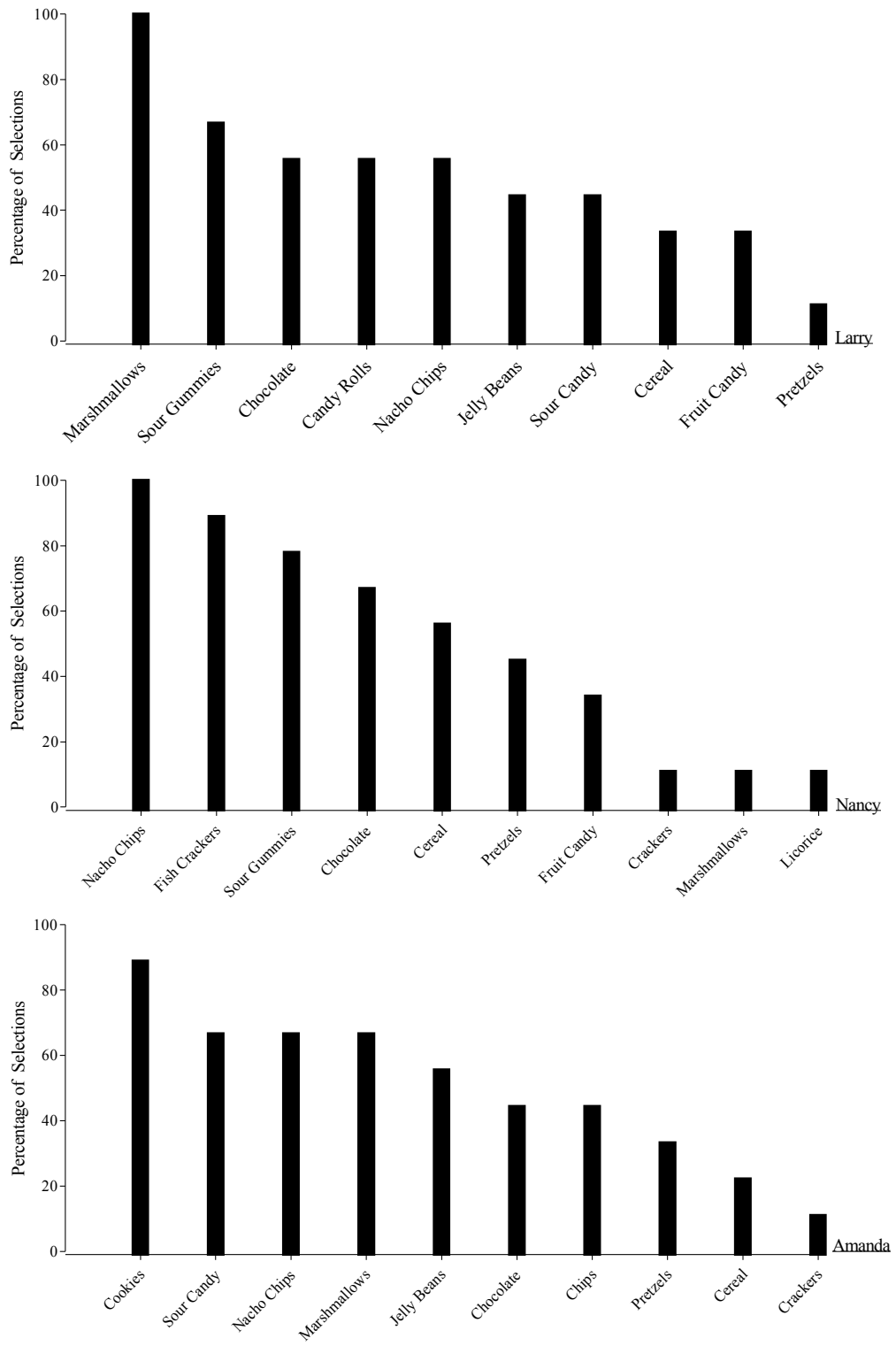


Figure 1. The percentage of trials participants chose each of the edible items during the paired stimulus preference assessment.

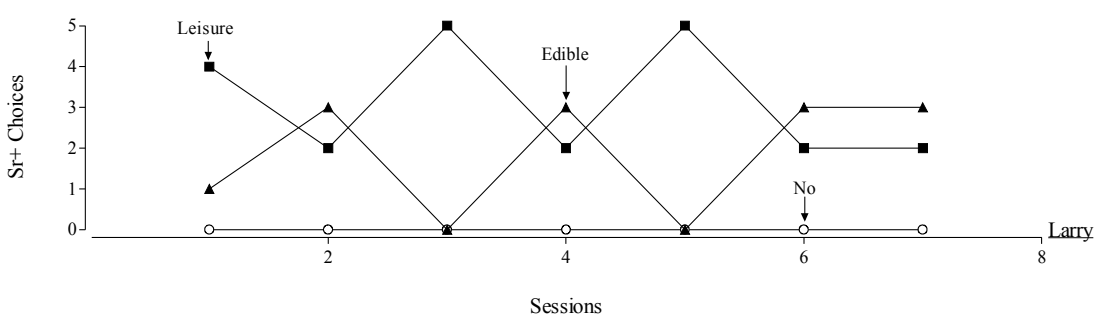
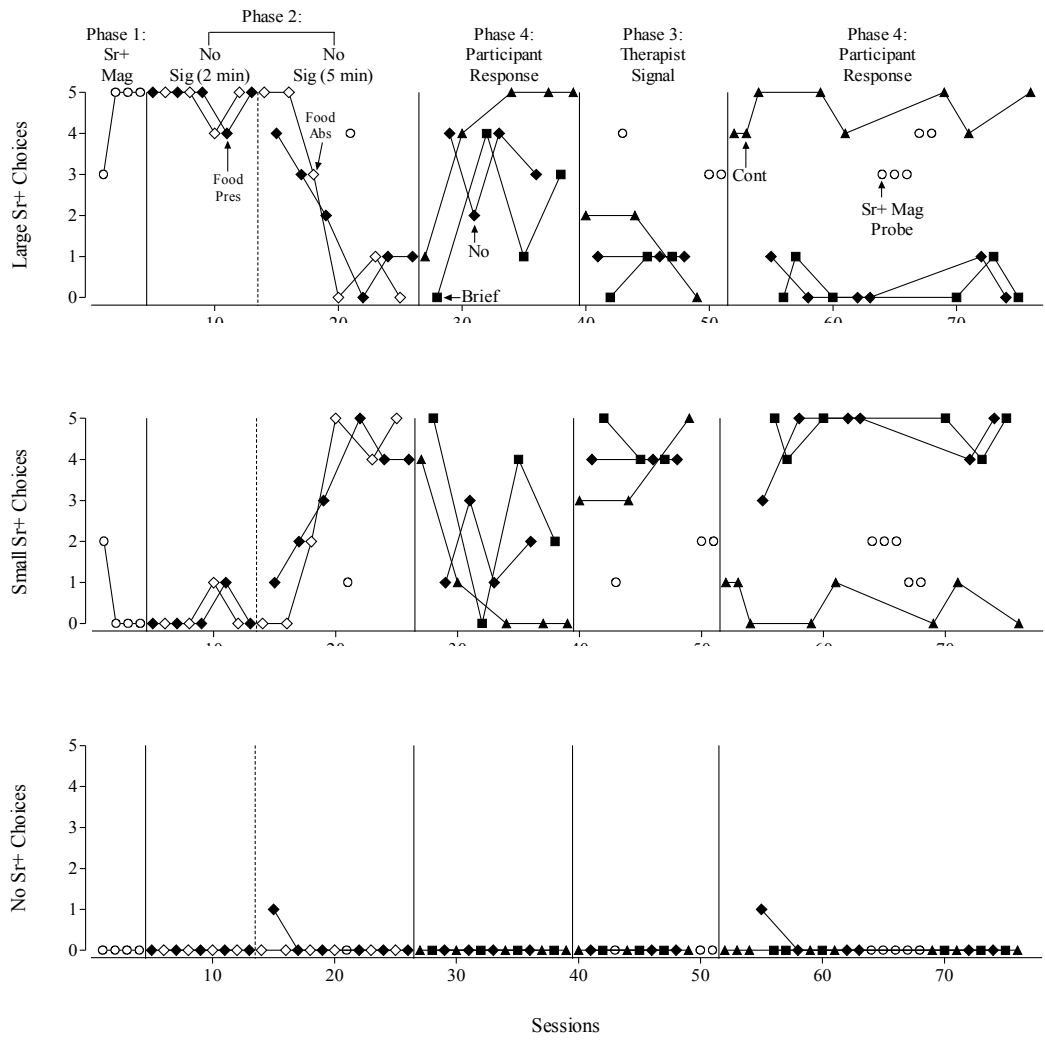


Figure 2. Larry's large-, small-, and no-reinforcer choices during phases 1-4 and his leisure-, edible-, and no-reinforcer choices during phase 5.

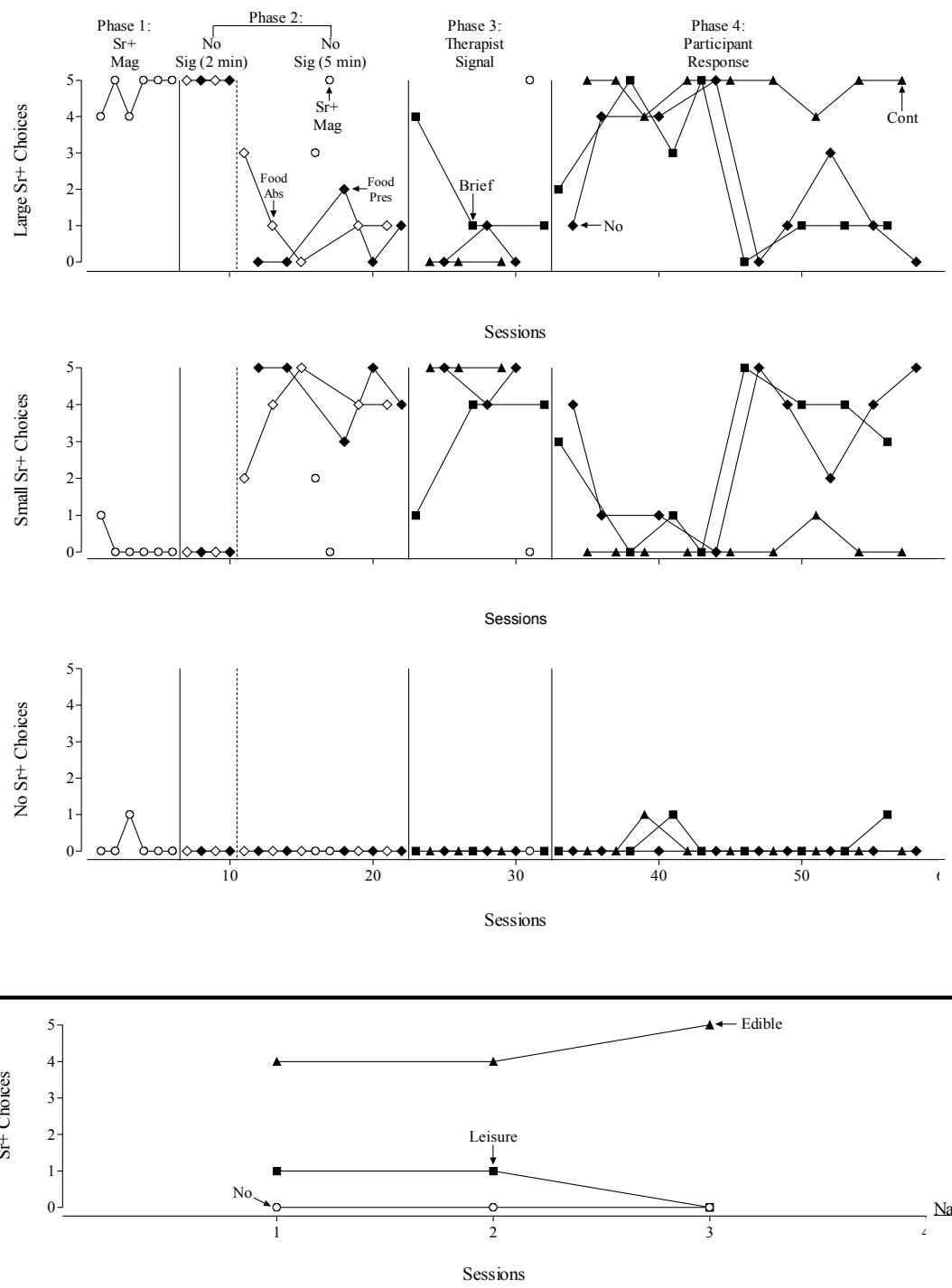


Figure 3. Nancy's large-, small-, and no-reinforcer choices during phases 1-4 and her leisure-, edible-, and no-reinforcer choices during phase 5.

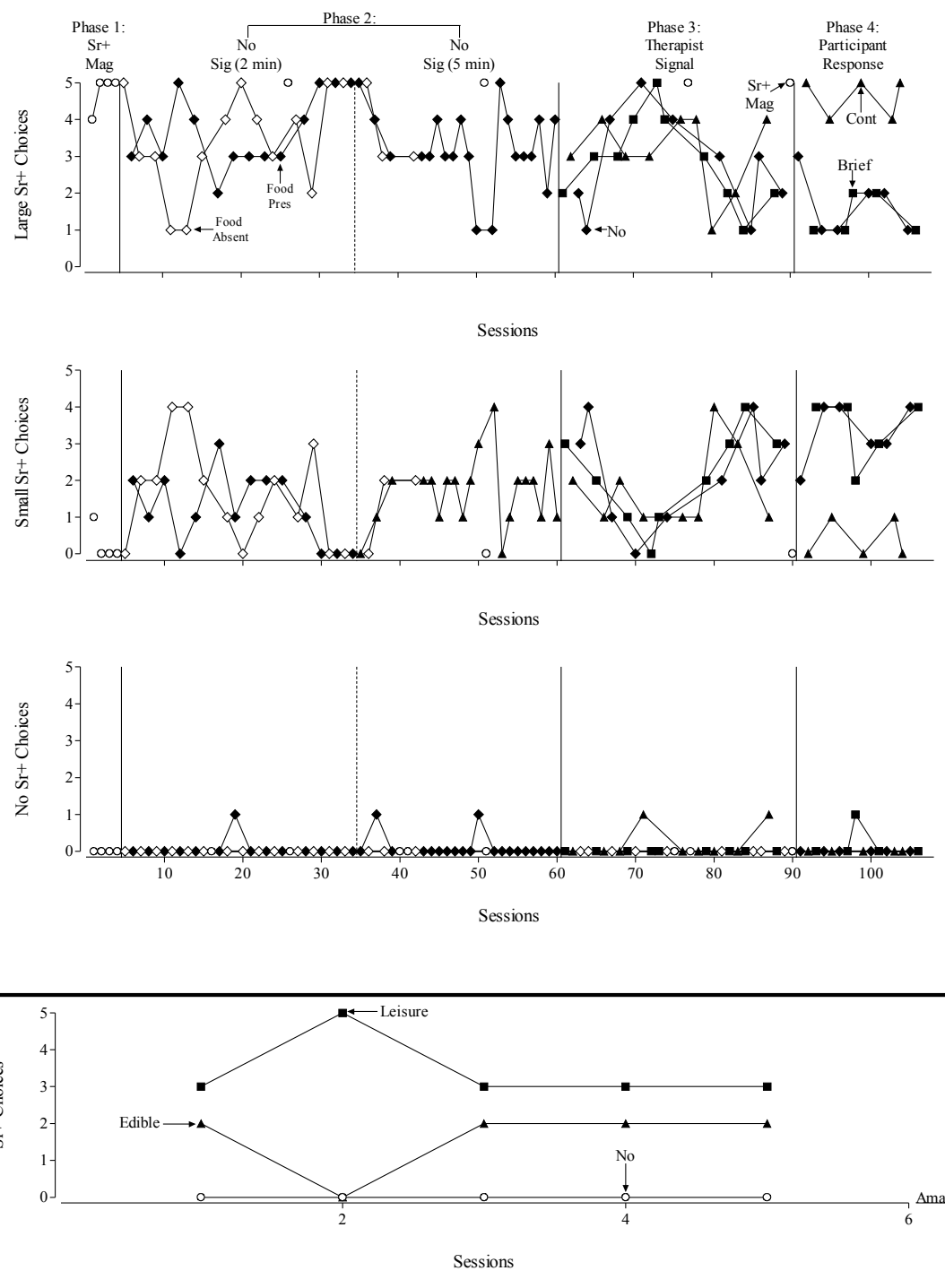


Figure 4. Amanda's large-, small-, and no-reinforcer choices during phases 1-4 and her leisure-, edible-, and no-reinforcer choices during phase 5.