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The distance travelled between points A and B depends on differences in reinforcement : a translational evaluation of transitions

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The Distance Travelled between Points A and B Depends on Differences in Reinforcement:

A Translational Evaluation of Transitions

By

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Abstract

In the experimental literature, transitions with nonhuman animals are typically framed as inescapable changes in signaled reinforcement schedules resulting in a pause in responding unique to switches from rich-to-lean schedules of reinforcement. Pausing is considered to be a function of the aversive qualities of the contrasting reinforcement schedules. By contrast, transitions are typically framed in applied research as physical changes in location evoking problem behavior maintained by the escape of a programmed aversive event and/or resumption of a programmed preferred event. We attempted to translate the basic framing of transitions to behaviors and contexts of social significance (Experiment 1), create a model for the investigation of problems related to transitions (Experiment 2), and evaluate a novel treatment for the problems evoked during rich-to-lean transitions (Experiment 3). Pausing was more readily observed during transitions from rich-to-lean contexts across both qualitative and quantitative differences in reinforcement. All participants' pausing was treated with unsignaled and probabilistic rich-reinforcement presented in the lean context.

Key words: multiple schedules, mixed schedules, post-reinforcement pause, problem behavior, transitions

The Distance Travelled between Points A and B Depends on Differences in Reinforcement: A Translational Evaluation of Transitions

Transitions between various types of contexts are inevitable throughout a child's day and are often accompanied by problem behavior such as tantrums when going to school (Repp & Karsh, 1994), off-task behavior between activities while at school (MacDuff, Krantz, & McClannahan, 1993), and noncompliance with bedtime routines (Mindell, Kuhn, Lewin, Meltzer, & Sadeh, 2006). Treatments for the difficulties associated with transitions are predicated on the notion that problem behavior during transitions is operant and therefore maintained by its consequences.

For example, McCord, Thomson, and Iwata (2001) assessed the relation between physically transitioning to and from preferred and non-preferred activities on the self-injurious behavior (SIB) of two participants diagnosed with intellectual disabilities. The upcoming activity was signaled during the prompt to change locations, and any problem behavior resulted in the termination of the transition and return to the previous activity. Both participants exhibited high rates of SIB during all transitions, whether or not the upcoming context was a non-preferred event (e.g., wiping the table) or no activity following the removal of a preferred item. As such, McCord et al. emphasized the physical movement of the transition itself as a determinant of problem behavior rather than the change in reinforcement context. In this preparation, the transition included a signaled physical change in location to other activities with escape from the transition to the initial preferred context provided contingent on problem behavior. Other applied studies have assessed physical transitions under similar arrangements and have suggested the function of the problem behavior to be related to a combination of positive reinforcement in the form of returned access to the preferred items in the initial context and negative reinforcement in the form of avoidance of the aversive items in the context to be experienced following the transition (e.g., Waters, Lerman, & Hovanetz, 2009).

In analyses with nonhuman animals, transitions have typically not involved any physical change in location but instead were designed around a change in signal between two different schedules of reinforcement resulting in a transitional state of responding (Perone & Courtney, 1992). In other words, the discriminable context change (e.g., a light changing from blue to yellow) created the transitions rather than any change in physical location. Unlike the applied research targeting severe problem behavior, the response most often observed when transitions are arranged during basic preparations is pausing.

Pausing is typically defined as the interval of time between the delivery of a reinforcer and the first response that is emitted thereafter (see Schlinger, Derenne, & Baron, 2008, for a review). Pausing is a ubiquitous phenomenon that can be observed across both simple and compound schedules of reinforcement and is attributed to the aversive properties of the contrast between the schedules. That is, even in situations in which only positive reinforcement is arranged following a transition, an upcoming leaner schedule of reinforcer delivery results in an overall aversive context (Perone, 2003).

Ferster and Skinner (1957) noted pausing more readily occurred during fixed schedules of reinforcement (whether interval or ratio were programmed). A fixed-interval schedule for the key pecks of a pigeon resulted in an initial pause following the reinforcer delivery and a positively accelerating rate, establishing a distinct scalloped pattern of responding. A fixed-ratio (FR) schedule of reinforcement resulted in a similar initial pause following the reinforcer delivery followed by a steady and rapid response rate which was termed a break-and-run pattern. Pausing has also been observed, albeit to a lesser extent, during variable-ratio (Schlinger, Blakely, & Kaczor, 1990) and variable-interval (Shull, 2004) schedules of reinforcement. The phenomenon of pausing during ratio schedules has drawn more attention than interval schedules as the rate of reinforcement is dependent on the rate of responding. Because the organism can maximize reinforcement by continuously responding, any pause is a curiosity as it decreases the rate that reinforcers can be produced.

Pausing during FR schedules of reinforcement has been termed a post-reinforcement pause as the duration of the pause has historically been hypothesized to be a function of the preceding schedule (Priddle-Higson, Lowe, & Harzem, 1976). However, others have suggested that pausing during simple schedules of reinforcement is more related to the stimuli correlated with the upcoming schedule (Griffiths & Thompson, 1973; Baron & Herpolsheimer, 1999). Williams, Saunders, and Perone (2011) synthesized previous research suggesting that pausing was related to the joint control of the previous and upcoming schedules of reinforcement in a compound schedules arrangement. Their Experiment 2 with persons with intellectual disabilities included transitions from rich (e.g., FR 10) and lean (e.g., FR 100) schedules of reinforcement in which points or monetary reinforcers were delivered in either mixed or multiple schedules. The inclusion of the two FR reinforcement schedules allowed for a comparison between four possible transitions: rich-to-rich, rich-to-lean, lean-to-rich, and lean-to-lean when transitions were signaled (multiple schedule) or unsignaled (mixed schedule). Extended pausing was observed almost exclusively during rich-to-lean transitions in which the upcoming schedule was signaled. Additional support for the joint control of pausing has been observed between components differing in reinforcer rate (Williams et al.), magnitude (Galuska, Wade-Galuska, Woods, & Winger, 2007), delay (Harris, Foster, Levine, & Temple, 2012), and response effort (Wade-Galuska, Perone, & Wirth, 2005) manipulations. However, pausing as a socially significant problem during transitions from rich-to-lean schedules of reinforcement has yet to be evaluated. Transitions have, to date, been interpreted differently across common basic and applied arrangements in relation to three dimensions: (a) whether physical movement to a different location is required during the transition, (b) whether differential consequences are provided allowing the organism to escape from the transition, and (c) whether the upcoming component following the transition includes aversive events.

In other words, applied transitions research has focused on movement between different locations and the programming of escape from components containing aversive events, whereas basic transitions research has focused primarily on phenomena generated by contrasting reinforcement schedules. Basic preparations often demonstrate pausing in the joint context of two reinforcement schedules, with the aversive controlling element being found in a discrepancy between features of the two signaled schedules of positive reinforcement. However, the applied works of McCord et al. (2001) and Waters et al. (2009) included transitions to aversive events in which case the problem behavior may have been affected by the contrast of the two activities (as in basic research) or may have simply been a function of the aversive properties of the end event of the transition. Furthermore, transitioning between activities of differing reinforcement value has not been explored in applied work, despite the apparent prevalence of such transitions (e.g., from playing video games to eating at the dinner table in the home, from recess to class activities at school).

Applied research on transitions has also differed from most basic preparations because problem behavior during the applied analyses resulted in the termination of the transition and re-access of preferred items in the initial context. By contrast, pausing during transitions from rich-to-lean schedules of reinforcement in basic research does not typically result in any programmed consequences[1]. This is not to say that the basic preparation lacks ecological validity. Problems such as running away when called to the table or sitting and refusing to get ready for bed may persist even when parents appropriately block and guide their child to the stated destination. Without considering the evocative control of contextual changes in reinforcement richness, the analyst may be perplexed as to the controlling variables when the consequences are accounted for.

We attempted to bridge the gap between basic and applied research on transitions in the current three-part study. Aspects of the basic arrangements were maintained; measures of behavior were made during signaled transitions between rich-to-rich, rich-to-lean, lean-to-rich, and lean-to-lean reinforcement. Aspects of the applied research were maintained; the transitions involved physical movement between two locations. However, by manipulating either the relative schedules of reinforcement or the relative quality of reinforcing activities, behavior during transitions was studied under only contexts of positive reinforcement. Two children whose parents reported difficulty with transitions in the home and community were included in Experiment 1, and the materials used in the transition analyses were relevant to these participating children. A more efficient model of transitions with additional measures of problem behavior was examined in Experiment 2 with the same two children from Experiment 1 and two additional children whose parents reported difficulty with transitions in the home and community. Following the establishment of baselines from the more efficient model of transitions from Experiment 2, a treatment for transition problems was evaluated during Experiment 3 with three of the four children, and a concurrent chains assessment of transition

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[1] A few studies have included an escape response that allows the pigeon to cancel the currently operating schedule of reinforcement and remove any signals correlated with the schedule of reinforcement (e.g., Azrin, 1961).

contexts was directly evaluated with one of the children to better understand the variables controlling treatment effects.

Experiment 1: Translation of Basic Arrangement

The phenomenon of pausing observed during signaled changes from rich-to-lean schedules of reinforcement suggests that this transition consists of aversive properties. Experiment 1 included the dependent measures of pausing, steps taken during physical transitions, and problem behavior during transitions between child-specific reinforcement contexts (e.g., free access to toys of varying preference) with two young children diagnosed with intellectual disabilities. In addition, we attempted to synthesize basic and applied procedural methodology by incorporating physical transitions to and from different reinforcement contexts in a 4-transition analysis.

Method

Participants and settings. Two male children diagnosed with pervasive developmental disorder receiving services from a local speech and language center in the New England area participated. Table 1 includes a list of participants across the three studies with their demographic information and the items included in the rich and lean contexts for each analysis. Flyers were distributed to the center, and students were referred based on parental/caregiver report of high levels of noncompliance when prompted to transition between contexts. Franco was a 4-year-old male. His motor skills were developmentally typical (e.g., he could feed himself using forks and spoons, and he could independently run and walk). Franco communicated in 3- to 4-word sentences, and he was able to receptively respond to full sentence instructions (e.g., go play with the Legos). His mother reported that she had difficulty transitioning him away from the TV, which typically ended in screaming, hitting others, and throwing objects.

Johan was a 3-year-old male with a limited verbal repertoire that included 1-word utterances. Johan reportedly required several gestural prompts when completing tasks or requests. Johan was able to independently walk to and from different locations and had good fine-motor skills such as the ability to string beads. His mother reported that Johan would exhibit problem behavior such as kicking, screaming/tantrums, biting others, and throwing objects typically when asked to go to novel situations or when required to leave his mother (e.g., going to daycare). Sessions for both participants were conducted in a 10 m x 14 m treatment room with one-way mirrors at a university.

Response definitions and interobserver agreement (IOA). Measures during physical transitions included problem behavior, pausing, and steps taken. *Problem behavior* included multiple forms of aggression, such as hitting or kicking others, and multiple forms of property destruction such as tearing and throwing objects. *Pausing* was defined as the total transition duration. The pausing interval began once the experimenter provided the prompt to transition to the next set of items/activities and concluded once the participant engaged with the relevant task or oriented toward the preferred items (e.g., DVD players) while in the second context. *Steps taken* was defined as the total number of times the participant lifted and planted each foot during a transition. Steps taken were recorded only within the pausing interval between the prompt to transition and the initial engagement with the specified activity. If the participant crawled, a step was counted for each placement of the knee to the floor.

Two observers independently recorded the duration of pausing and counts of problem behavior and steps taken during each transition. Each transition was considered a trial, and the second observer watched videos of all trials within randomly chosen sessions. IOA for pausing was determined by dividing the larger duration by the smaller duration for each trial and multiplying it by 100 to get a percentage. The scores for the trials were then averaged to provide the IOA for an entire session. IOA for problem behavior and steps taken was determined by dividing the larger frequency by the smaller frequency per trial and averaging all trials to provide a percentage for each session. If both observers recorded no problem behavior, their agreement was considered 100% for the trial. A second observer recorded data during 38% of Franco's analysis and the IOA for pausing, problem behavior, and steps taken was 96% (89% to 100%), 100% and 98% (86% to 100%), respectively. A second observer recorded data during 59% of Johan's analysis and the IOA for pausing, problem behavior, and steps taken was 94% (90% to 100%), 100%, and 94% (84% to 100%) respectively.

Franco procedure. During the 4-transition analysis for Franco, the room was divided, using colored mats, into four equal areas to form a quadrant (Figure 1). Each context was 2 m x 2 m (4-m transition) and of a different color that was correlated with a specific schedule of reinforcement (i.e., rich or lean). Green and yellow areas of the quadrant were correlated with the rich-reinforcement context and blue and red areas were correlated with the lean-reinforcement context. The items in one rich (or lean) context were identical to the items in the other rich (or lean) context. Contexts were correlated with different colors to create a multiple-schedules arrangement because previous research suggested that pausing would not be observed during mixed schedules without these signals.

Sessions were approximately 10 min and consisted of a set of four transitions, which required experience in either two rich and three lean or three rich and two lean contexts. The number of experienced rich or lean contexts depended on which context was presented first, as the initial context always served as the final context. Using Figure 1 as an example, if Franco were to start clockwise transitions in the top right rich context, the first transition will be from rich to lean and his last transition will be from rich to rich. Franco would then have experienced three rich contexts and two leans contexts. Each reinforcement context was 2 min and consisted of uninterrupted free play. All forms of problem behavior (e.g., aggression or property destruction) were ignored throughout the assessment with no differential consequences provided.

Transitions were presented in a counterbalanced order within a session but the set of transitions to be included was randomized across sessions. Requiring one of each transition within one session allowed for a combination of four possible sets of transitions and these sets were chosen every session by a random number generator. Franco was prompted to transition only between different contexts adjacent to the currently occupied context. This ensured that each transition was equidistant by excluding any diagonal crosses between contexts. Each session included one of each transition in each of the four contexts, requiring all transitions to be in a clockwise or counter clockwise direction within one session.

The quality or preference of activities available during each reinforcement context was varied, based on the results of a multiple stimulus without replacement assessment (MSWO; DeLeon & Iwata, 1996). The activity that ranked the highest on average was included in the rich-reinforcement context and the activity that ranked the lowest on average (but still approached and engaged with by the participant) was included in the lean-reinforcement context. The activities were placed in opaque boxes with colors corresponding to the relative context. The activities of a particular context were visible to Franco only while he was in that particular context. However, prior to each session, the activities were placed in each box in front of Franco and he was informed which activities were in which colored box (e.g., “the markers go into the blue box”).

Franco was initially informed that “it was time to play with the [activity]” in which case he was given continuous access to the specified activity. The activities had to remain within the corner of each context to ensure an equal distance between each transition. If Franco attempted to play with the toys in a different location, the items would be removed from his access and replaced in the specific corner; however this did not occur. After 2 min, Franco was provided with the prompt: “We are finished playing with the [activity]. It is now time to play with the [colored context] toys” while the experimenter pointed to the next context. The experimenter then shadowed Franco and blocked any attempts to access activities in contexts not specified in the prompt. When Franco successfully transitioned to the new activity, he was provided with brief praise and was given the activities in the corresponding context. If Franco did not begin to transition with the initial verbal prompt, the prompt was then repeated every 30 s. Franco was never physically guided to transition; however, materials from the initial activity were removed following the second prompt.

Johan procedure. Johan’s arrangement can be seen in Figure 2. The procedures for Johan included varying the quality and rate of reinforcement across the rich and lean contexts. Johan was given edible items contingent on accurate responding during a sorting task. The rich context included more-preferred edibles, based on a previously conducted MSWO, presented on an FR-1 schedule whereas the lean context included less-preferred edibles presented on an FR-5 schedule. During the sorting task, Johan was instructed to sort two different shapes of plastic blocks every 5 s. At least one block of each shape was visible in each of the two clear bins when Johan was prompted to “sort” the item. If Johan did not comply, he was prompted with a least-to-most procedure (i.e., verbal, gestural, physical prompting). Praise and edibles were delivered only following compliance with the verbal and gestural prompts.

During Johan’s 4-transition analysis, only two areas from the quadrant were included and the areas were not correlated with rich or lean reinforcement (Figure 2). Instead, the sorting material was color specific to the rich- (green blocks) or lean- (red blocks) reinforcement context. Thus, the color of the sorting material served as the signals, creating the multiple-schedule arrangement. This arrangement included only one 4-m area to transition back and forth between two reinforcement contexts. Each context could be either rich or lean depending on the programmed upcoming schedule. The reinforcement contexts were presented in a randomized (not counterbalanced) order; therefore Johan did not necessarily experience all four possible transitions in a single session. An equal number of red and green identical sorting blocks was placed in opaque bins. Once the 1-min task was complete, the transition was initiated with the experimenter randomly choosing an item from the bin. The experimenter then stated that the sorting task was finished and that “it is now time to sort [object color] over there” with a corresponding gestural prompt. When Johan successfully transitioned to the other context, he was provided with brief praise, and the new sorting task began.

Johan’s procedures were also modified to include his mother in the sessions. It was observed that Johan would tantrum whenever his mother was removed from the session room. In addition, the mother reported that Johan rarely left her side outside of session, so we decided that it was not appropriate to remove him from her presence during these sessions. Johan’s mother was placed equidistant from each task and ignored all bids for her attention with no eye contact provided during session. However, Johan was not physically blocked from his mother, and at any point during the assessment he could elope to her side. If elopement occurred during the transition it was included in the measurement of pausing and steps taken. If elopement occurred outside of the transition, during the reinforcement context, it was not counted in the measurement of pausing and steps taken. Following the completion of each session, Johan was given a 3 to 5 min break with his mother.

Sessions for Johan's 4-transition analysis were approximately 5 min and consisted of a maximum of five 1-min transitions, or until he no longer complied with the prompts to transition. The transition to the upcoming context was terminated if Johan did not begin to transition before the end of the 1-min context. Johan was never physically removed from his mother if he eloped during the transition and was only provided with verbal prompts every 15 s until the 1-min elapsed. Although this criterion was included for all participants, Johan was the only participant to have experienced the session termination due to noncompliance. During this scenario, Johan's pausing duration was recorded as the maximum allowable time and his steps taken were recorded as equal to the largest frequency. The maximum allowable time and largest frequency of steps taken for Johan was 60 s and 50 steps.

Results and Discussion

No problem behavior was observed during Franco's entire analysis. Low rates of problem behavior were observed during Johan's analysis, with more problem behavior observed during transitions from rich-to-lean contexts (*M* = .6 rpm) than in transitions from rich-to-rich contexts (*M* = .1 rpm); no problem behavior was observed during transitions from lean-to-rich or lean-to-lean contexts.

Pausing and steps taken for both Franco and Johan's transitions analyses are presented in Figure 3. Extended pausing was observed with Franco during the transition from rich-to-lean (*M* = 31 s, *SD* = 5) reinforcement contexts, whereas little pausing was observed during the lean-to-rich (*M* = 6 s, *SD* = 1). Moderate pausing was observed during the rich-to-rich (*M* = 17 s, *SD* = 19) and lean-to-lean transitions (*M* = 18 s, *SD* = 15). Franco's frequency of steps taken (bottom left panel) was similar to the pausing measurement in that the most steps taken occurred during the rich-to-lean transitions (*M* = 25, *SD* = 14) with fewer steps taken during the lean-to-rich (*M* = 8, *SD* = 1), lean-to-lean (*M* = 13, *SD* = 9), and rich-to-rich (*M* = 9, *SD* = 2) contexts.

Extended pausing was observed for Johan during the rich-to-lean transitions (*M* = 41 s, *SD* = 19). The durations of pausing during the rich-to-rich (*M* = 27 s, *SD* = 23) and lean-to-lean transitions (*M* = 27 s, *SD* = 15) were similar with the least amount of pausing observed during the lean-to-rich transitions (*M* = 17 s, *SD* = 7). We observed a high correspondence between pausing and steps taken (bottom right panel) with Johan as an increasing trend of frequency of steps taken was observed during the rich-to-lean transitions (*M* = 34, *SD* = 15) and the lowest frequency observed during the transitions from lean-to-rich contexts (*M* = 17, *SD* = 5). Similar frequencies of steps taken were observed during the rich-to-rich (*M* = 23, *SD* = 18) and lean-to-lean transitions (*M* = 35, *SD* = 22).

Although the measures of pausing and steps taken will likely covary during an analysis of physical transitions, when considering noncompliance with instructions to complete a task, these measures may not always correlate. For example, when told to come into the classroom, a child could refuse to move from the swings (extended pausing with minimal steps taken) or run away until physically guided (extended pausing with more steps taken). Both measures were therefore included to ensure the proper description of transition difficulties.

The results of the transitions analyses are aggregated and presented in Figure 4 in a format often found in basic research (e.g., Perone & Courtney, 1992; Williams et al., 2011). For both participants, there was an overall increase in pausing during rich-to-lean transitions in comparison to lean-to-lean transitions. In addition, the greatest difference in pausing was observed between transitions from rich-to-lean contexts and any transitions to rich contexts. This suggests that extended pausing was not simply a function of the upcoming schedule but specific to the transition that includes a previous rich and an upcoming lean context. If the behavior was affected only by the previous schedule, extended pausing would be observed in any transition from lean schedules. On the other hand, if the behavior was affected only by the upcoming schedule, extended pausing would be observed in any transition to lean schedules. It is this combination of experience with the previous contingency and discrimination of an upcoming change in reinforcement, found exclusively in rich to lean transitions, that appears to result in a generally aversive context for transitions.

This is not to say that the upcoming schedule alone has no effects. In fact, upcoming schedule effects were observed in that there was slightly greater pausing across participants during the lean-to-lean transitions in comparison to the lean-to-rich transitions. The increasing trend in extended pausing during the lean-to-lean transitions of Franco's analysis could be indicative of the effects of any transition to lean schedules regardless of the previous context. This effect was also observed in basic experiments (e.g., Perone, 2003)—although only means were reported, which precludes any analysis of trends or variability—and is related to the proportional value of the lean schedule. In other words, as the ratio requirement of the lean schedule of reinforcement is systematically increased in relation to a static rich schedule, the pausing during transitions from lean-to-lean contexts increases in addition to the extended pausing seen during transitions from rich-to-lean contexts (see Figure 6 from Perone, 2003).

In Experiment 1, we observed differential pausing in a socially significant preparation and replicated the effects often observed in the basic literature on transitions. However, efficiency was largely ignored to ensure experimental rigor. In Experiment 2, we implemented a more practical assessment involving only the two transitions likely to produce differential pausing.

Experiment 2: Establishing a Practical Assessment

In Experiment 1, we included all four transitions (i.e., rich-to-rich, rich-to-lean, lean-to-rich, and lean-to-lean) to determine if our measure of pausing was jointly controlled by the signaled upcoming lean schedule of reinforcement and the transition from the rich schedule of reinforcement. However, including all four transitions extended the time it took to complete the assessment resulting in a less efficient process. Furthermore, detecting a difference between lean-to-rich and rich-to-lean transitions may provide a sufficient baseline for treatment without the need of the two like transitions (i.e., rich-to-rich and lean-to-lean). Therefore, reducing the process to a 2-transition analysis reduces the precision of the analysis but increases its practical utility by maintaining the transitions for which the problem can be said to exist.

In Experiment 2, we examined whether a two transitions analysis (rich-to-lean and lean-to-rich) would be useful for determining whether pausing and problem behavior was sensitive to shifts in relative qualities or quantities of reinforcement.

Method

Participants and settings. Four participants, two children (Ian and Duke) in addition to Franco and Johan from Experiment 1, were included. Ian was a 6-year-old boy diagnosed with autism spectrum disorder (ASD). Ian had mastered both general fine-motor and gross-motor tasks and could speak in full sentences. Ian was referred by his caregivers due to reports of requiring repeated instructions when asked to leave preferred activities such as watching TV or playing with an iPad®. In addition, these episodes were reported to often result in crying, tantruming, or yelling.

Duke was a typically-developing 4-year-old boy with no reports by his caregivers of strong concerns related to his transitions. In contrast to other participants, Duke was included to determine if the measures in this new arrangement showed sensitivity to the differences in reinforcement for a child without reports of severe problem behavior. Transitioning children seems to be a ubiquitous problem for parents, whether or not the children exhibit severe problem behavior. Duke was therefore specifically included to assess the generality of this problem. The sessions were conducted in the same room as described from Experiment 1; one context was paired with rich (red for Johan, Franco, and Ian, and blue for Duke) and another with lean (green for Johan, blue for Franco and Ian, red for Duke) reinforcement.

Response definitions and interoberserver agreement. Response measures were identical to Experiment 1 with the inclusion of a third measure of movement for one participant. *Movement* was defined as the actual path travelled during the transitions, and was included to provide a qualitatively rich depiction of the transition. All sessions for Johan were videotaped from the midpoint of his arrangement and the path of each physical transition was recorded on a translucent projector sheet and graphed using the program GetData®.

A second observer independently recorded data during at least 42% of the sessions across the four participants. IOA for pausing, problem behavior, and steps taken during Johan’s analysis was 96% (92% to 100%), 100%, and 94% (88% to 100%), respectively. IOA for pausing, problem behavior, and steps taken during Franco’s analysis was 91% (82% to 99%), 100%, and 97% (94% to 100%), respectively. IOA for pausing, problem behavior, and steps taken during Duke’s analysis was 96% (90% to 100%), 100%, and 98% (89% to 100%), respectively. IOA for pausing, problem behavior, and steps taken during Ian’s analysis was 95% (90% to 100%), 100%, and 98% (88% to 100%) respectively.

A second observer independently recorded 29% of random transitions on a second translucent projector sheet which was then fed into the graphing program. The graphing program GetData® then created values for the transition lines and broke each line into approximately 50 units. Each unit was given an x-axis and y-axis value. IOA for movement was calculated by taking the larger unit and dividing it by the respective smaller unit for both x and y-axis values then multiplying the mean by 100. IOA for Johan's movement was 90% (85% to 94%).

Experimental design. The two transitions (rich-to-lean and lean-to-rich) were presented in a rapidly alternating order. In other words, transition types were never repeated consecutively and the past context was always different from the upcoming context. This method of transitioning lends itself to a rapidly-alternating design as each reinforcement context serves as the past context in the transition to the upcoming one.

Procedure. Each session of the 2-transition analysis was 14 min (6 transitions total consisting of 7 two-minute contexts) and was procedurally similar to Franco's analysis from Experiment 1 with one exception. *Two* of the more preferred activities from the MSWO were included in the rich context to ensure a greater disparity in quality between the rich and lean contexts (i.e., the quality *and* amount of the toys was greater in the rich context).

The analysis included a minimum of 4 rich-to-lean and 3 comparative lean-to-rich transitions. Participants were provided free access to preferred activities in each context for 2 min. The items during this analysis were visible throughout the assessment and were correlated with the color of the context. The rich context included more-preferred activities and the lean context included less-preferred activities. Following a rich reinforcement context, the participant could only transition to a lean reinforcement context, and vice versa. Sessions were terminated if the participant did not complete a transition following the prompt within 2 min and pausing was set as the maximum possible duration, whereas steps taken was set as equal to the most steps that have been taken during a transition. However, all transitions were completed within 2 min during these analyses across participants.

Procedures were identical across participants with two exceptions for Johan. Because Johan could not play with toys alone, an analyst provided high-quality attention across both contexts. The quality of attention remained constant between the rich and lean contexts with only the preference of the items determining the disparity in reinforcement quality. The analyst never prompted Johan to play with the toys in a certain way, although the analyst did model appropriate play with each item. Much like the preparation for Johan during Experiment 1, his mother was included in the analysis and present equidistant from each context. Johan's mother withheld all attention or eye contact and ignored all bids for attention during the assessment.

Results and Discussion

Problem behavior was only observed during Johan's analysis at low levels, and outside of the transitions interval (*M* = .1 rpm, *SD* = .2). The other results of Johan's analysis are presented in Figure 5 (first panel). Extended pausing (*M* = 40 s, *SD* = 37) and a higher frequency of steps taken (*M* = 23, *SD* = 10) were observed during the rich-to-lean transitions in comparison to the pausing (*M* = 4 s, *SD* = 1) and steps taken (*M* = 10, *SD* = 2) during the lean-to-rich transitions. Extended pausing (*M* = 17 s, *SD* = 9) and a high frequency of steps taken (*M* = 18, *SD* = 5) were also observed during the rich-to-lean transitions of Franco's analysis (second panel). Whereas, a shorter duration of pausing (*M* = 6 s, *SD* = 1) and fewer steps taken (*M* = 13, *SD* = 1) were observed during Franco's transitions from lean-to-rich contexts.

The results of Duke's analysis are presented in the third panel of Figure 5. Although, less pronounced differences were observed in comparison to the two participants with whom transitions were reported to be a parental concern, Duke exhibited longer durations of pausing during the rich-to-lean transitions (*M* = 13 s, *SD* = 13) in comparison to the lean-to-rich transitions (*M* = 5 s, *SD* = 2). In addition, more steps were consistently taken in the rich-to-lean transitions (*M* = 8, *SD* = 1) in comparison to the lean-to-rich transitions (*M* = 6, *SD* = 0.4).

An increasing trend in pausing (*M* = 23 s, *SD* = 26) was observed during the rich-to-lean transitions of Ian's analysis (Figure 5, bottom panel) with a steady state of little pausing (*M* = 3 s, *SD* = 1) observed during lean-to-rich transitions. With the exception of the initial session, more steps were consistently taken during transitions from rich-to-lean contexts (*M* = 11, *SD* = 3) in comparison to lean-to-rich contexts (*M* = 6, *SD* = 2).

Johan's physical movement during all transitions is represented in Figure 6. There were 7 transitions total (4 rich-to-lean, 3 lean-to-rich) and each panel in Figure 6 includes two consecutive transitions, one rich-to-lean and one lean-to-rich. The last panel only includes a transition from rich-to-lean as that was the last transition of the analysis. Johan meandered the most during transitions only from rich-to-lean contexts in comparison to transitions from rich-to-lean contexts. In addition, Johan travelled away from the lean items towards his mother in 3 out of 4 of the rich-to-lean transitions. During one transition, Johan attempted to meander back to the rich context before being blocked access and returned to his mother, and eventually the lean context. Meandering was exclusively observed during transitions from rich-to-lean contexts.

These results showed that transition problems could be adequately captured in a 2-condition analysis. The results of Experiment 2 also showed that changes in behavior during transitions may be determined by qualitative differences of reinforcement, and these findings were apparent across multiple measures. Specifically, extended pausing, increased steps taken, and more meandering were observed during transitions from rich-to-lean reinforcement (in contrast to lean-to-rich reinforcement). The generality of the phenomenon was also extended by arranging varying forms of leanness and richness across both experiments. Reinforcement was manipulated in two ways: quantitative manipulation via varying rates of reinforcement and qualitative manipulation via varying preference for leisure items.

Problems during transitions were observed only when different reinforcer types or amounts were arranged in the back-to-back contexts and in the absence of differential consequences applied to behavior during transitions. In other words, transitioning to the next context resulted in the same reinforcers whether or not the participant paused or meandered. From this arrangement, a practical baseline was developed with two functions. The 2-transition analysis not only established a viable baseline condition to assess differences in pausing once a treatment is introduced but allowed for further interpretation of the unique properties of rich-to-lean transitions as a minimum of two transitions was required throughout the assessment at all times. In other words, relative fluctuations in context "richness" can be analyzed when the participants' transition back to the rich items before and after the treatment is introduced. This analysis is limited, however, in that it provided an efficient means of describing problems during transitions but does not demonstrate how to treat the pausing or meandering.

Experiment 3: Evaluating Possible Treatment

The results from Experiment 2 provided a practical model for establishing a baseline rate of pausing during transitions, allowing for an evaluation of possible treatments. We conducted Experiment 3 to evaluate a treatment of unsignaled and probabilistic reinforcement to reduce pausing during the transitions from rich-to-lean reinforcement contexts. The stimuli correlated with lean reinforcement were removed to simulate a mixed schedule whereby extended pausing is not readily observed (Williams et al., 2011).

Method

Participants and settings. With the exception of Duke (whose parents were not interested in a treatment), all participants from the previous studies were included. The quadrants were again split into two halves (each correlated with their own reinforcement contexts) and the child transitioned back and forth between the rich and lean contexts.

Response definitions and interoberserver agreement. Measures were identical to Experiment 1. A second observer independently recorded data during at least 30% of the sessions across the three participants. IOA for pausing, problem behavior, and steps taken during Johan's treatment evaluation was 98% (97% to 100%), 100%, and 96% (92% to 100%) respectively. IOA for pausing, problem behavior, and steps taken during Franco's treatment evaluation was 90%, (88% to 93%), 100%, and 100%, respectively. IOA for pausing, problem behavior, and steps taken during Ian's treatment evaluation was 95% (89% to 100%), 100%, and 96% (80% to 100%), respectively.

In order to better understand the variables responsible for observed effects of treatment, a concurrent-chains preference assessment (Luczynski & Hanley, 2009; 2010) was also conducted for Ian who was given a choice between transitioning to the rich, lean, and treatment contexts. The items were placed 3.7 m away from Ian and a selection was defined as moving towards and touching the item. IOA was calculated as an exact agreement per trial and was collected during at least 25% of the assessment. IOA for the context selected during Ian's preference assessment was 100%.

Experimental design. Treatment was implemented in a non-concurrent multiple-baseline design across participants. In addition, an ABA reversal was imbedded into the multiple-baseline design with Johan to provide a within-subject replication. A return to the treatment condition with Johan was not completed because the family was unavailable for further visits. Although the alternation between transitioning from rich-to-lean and lean-to-rich reinforcement was required in this assessment (i.e., to transition from rich-to-lean contexts the participant must transition back to rich following a lean reinforcement context), the data from lean to rich are not reported further because treatment effects were measured only during the rich-to-lean transitions.

Procedure. Each session was 14 to 18 min, and baseline sessions were procedurally identical to the 2-transition analysis from Experiment 2, which included 6 transitions in each session. During baseline, the participant was given access to the more-preferred item in the rich-reinforcement context and was prompted after 2 min to transition to the less-preferred item making up the lean-reinforcement context. Following the 2 min in the lean context, the child was prompted to transition to the rich context. All items were visible throughout the baseline phase. The results from the 2-transition analysis served as the baseline for Johan's treatment evaluation, an additional two baseline sessions were conducted with Franco's 2-transition analysis to establish an adequate baseline, and an entirely new baseline was conducted for Ian's treatment evaluation.

The treatment condition included an opaque bin, considered the "mystery toys," with a color correlated with the less-preferred activity in a mixed-schedule format. Thus, the activities in the lean context were now not visible when the participant was prompted to transition from the rich-reinforcement context. In addition, the probability of the lean context containing a less-preferred activity was reduced from 100% to 50%. This meant that on some occasions during the participants' transitions from the rich-to-lean context, the less-preferred activity was replaced with the same more-preferred activities available in the rich context. In other words, when the participant completed a transition to the traditionally lean context, they were provided more-preferred activities on half of the occasions. In addition, there was no indication of whether the more-preferred or less-preferred activities would appear because the activities were kept in the opaque bin until the participant completed the transition. The treatment context can then be understood as a mixed schedule with probabilistic reinforcement because its content was unsignaled and the lean context sometimes contained the more-preferred activities and sometimes contained the less-preferred activities.

Treatment sessions were extended to 18 min to include at least four rich-to-lean transitions (individual context durations remained constant throughout the assessment). This allowed for an equal number of randomly presented more- and less-preferred activities to be included in each session. Each session therefore had two more-preferred and two less-preferred activities that would appear in the lean context in a randomized order. All prompts were identical to baseline, and the participant was not provided with information about the items that would be in the bin at any given transition. Instead, when it was time to transition from the rich-to-lean context, the participant was prompted to “play with the mystery toys.” The order of less- and more-preferred activities that would be placed in the bin was determined prior to each session using a random number generator.

There were no modifications made to the lean-to-rich transitions. During the treatment phase, however, this transition was dependent on what set of activities were presented during the mixed-schedule context. Following the completion of the mixed-schedule context the participant was prompted to engage with the more-preferred activities that were freely visible throughout the entire assessment. This meant that on some occasions the participant would be transitioning from the unsignaled more-preferred activities in the lean context to the identical more-preferred activities in the rich context. If more-preferred activities were programmed to be delivered in the mixed-schedule context, it essentially established the next transition as a rich-to-rich transition identical to that of Experiment 1. If less-preferred activities were programmed to be delivered in the mixed-schedule context, it established the next transition as a lean-to-rich transition identical to that of Experiment 1.

If any target or problem behavior occurred at any time during the session, it resulted in no scheduled consequences. The items used in each context were available to the participant irrespective of the behavior that may have occurred. In other words the unsignaled more-preferred items were still presented, if scheduled, as soon as the participant completed the transition whether or not extended pausing, meandering, or other problem behavior occurred.

Post-hoc secondary analysis. A post-hoc secondary analysis was conducted for all three participants following the treatment evaluation. The pausing duration during each lean-to-rich transition was subtracted from the pausing duration during the relative rich-to-lean transition and then calculated as a mean across all transitions. The mean difference during the baseline phase was then compared with the mean difference during the treatment phase. Positive values suggest that more pausing was observed during transitions from rich-to-lean contexts and negative values would suggest that more pausing was observed during transitions from lean-to-rich contexts. The post-hoc secondary analysis was conducted to determine relative shifts in pausing once the treatment was in place and whether transitions to the rich component from the mixed-schedule context would be affected.

Preference assessment. A concurrent-chains preference assessment was conducted for Ian following the treatment evaluation to determine his preference for the contexts to which he was transitioning. In addition, the preference assessment was conducted to help understand the treatment effects as an extension to the previous assessment. Determining the relative value of each context aided in interpretation of behavioral processes resulting in reduced pausing following the treatment introduction.

Ian was given a choice of three contexts: (a) an area with the more-preferred activities visible, (b) an area with the less-preferred activity visible, and (c) an area with an opaque box that either contained the more-preferred activities or the less-preferred activity (e.g., the mixed-schedule context experienced by Ian in the previous assessment). This preference assessment was completed to determine if Ian preferred the mixed-schedule context to the signaled rich context despite the overall decrease in the amount of access to his more-preferred activities. Prior to each transition, Ian was given the prompt to choose one; following which he could then transition to the activity selected. After 1-min of access to the activity, the array was reset, and the selection process was repeated.

The probability of the more-preferred items being available in the mixed-schedule context was manipulated across phases in a reversal design. Initially, more-preferred activities were available for 50% of the trials (as in the treatment condition); then more-preferred activities were never available in the mixed-schedule context. A return to more-preferred activities being available 50% of the time completed the reversal. During this analysis, the treatment activities were placed in an opaque box with a specific color correlated with each mixed-schedule context (yellow for the 50% and blue for the 0%). The 50% and 0% comparison was conducted to determine if preference was influenced by the unsignaled and probabilistic reinforcement arrangement (evident by a preference for the mixed-schedule context only during the 50% phases) or was controlled by an artifact of the procedures like the mystery box label assigned to the mixed-schedule context and described to Ian (control by this artifact would be evident by a preference for the mystery box context across all phases).

Results and Discussion

Only three instances of problem behavior were observed during Johan's treatment evaluation, two of which were during transitions from rich-to-lean contexts and the other occurring outside of the transition intervals. The top panel of Figure 7 depicts the results of the treatment evaluation for Johan. There was an increasing trend in pausing (*M* = 40 s, *SD* = 37) and a greater number of steps (*M* = 23, *SD* = 10) was observed during the first baseline phase. By contrast, pausing (*M* = 8 s, *SD* = 4) and steps taken (*M* = 12, *SD* = 1) were lower following the introduction of treatment. Long pauses (*M* = 114, *SD* = 8) and a greater number of steps taken (*M* = 40, *SD* = 0) were recovered in the return to baseline.

The results of Franco's treatment evaluation are presented in Figure 7 (middle panel). There was a decrease in pausing during the treatment phase (*M* = 15, *SD* = 7) in comparison to the baseline phase (*M* = 7 s, *SD* = 2) with a less pronounced difference in steps taken from baseline (*M* = 16, *SD* = 5) to treatment (*M* = 13, *SD* = 2).

An increasing trend in pausing was observed during the baseline condition (*M* = 12 s, *SD* = 8) of Ian's treatment evaluation (bottom panel); however, following the introduction of treatment, pausing decreased to levels below that of baseline (*M* = 4 s, *SD* = 3). In addition, the overall number of steps taken was lower during treatment (*M* = 7, *SD* = 2) in comparison to the baseline frequency (*M* = 10, *SD* = 2).

The results of the post-hoc secondary analysis are presented in Figure 8. Positive difference values would be expected and were indeed observed across the three participants prior to the introduction of treatment (*M* = 23; *SD* = 23). Values close to zero might be expected as a function of the successful treatment, but that was not detected. Instead, negative difference values were observed following the introduction of treatment (*M* = -9; *SD* = 11) for all participants. Participants not only paused less during rich-to-lean transitions following the introduction of the treatment but also they began to pause relatively more when transitioning back to the rich context from the mixed-schedule context, suggesting that the rich context was less reinforcing relative to the mixed-schedule context. This notion was more directly evaluated in a subsequent concurrent chains assessment with Ian.

Irrespective of transition type, there was an overall improvement in pausing and steps taken following the introduction of treatment. The post-hoc secondary analysis may have evinced a relational shift during transitions (i.e., less pausing during rich-to-lean and more pausing during lean-to-rich); however, across participants there was more pausing (*M* = 16 s, *SD* = 20) and steps taken (*M* = 13.2, *SD* = 8) during baseline in comparison to pausing (*M* = 10 s, *SD* = 13) and steps taken (*M* = 10 s, *SD* = 5) during treatment. Thus, despite the lengthier pausing during the lean to rich transition in treatment relative to baseline, there was still an overall decrease in pausing and steps taken with respect to all transitions when treatment was implemented.

The results of Ian's concurrent-chains assessment are presented in Figure 9. When the treatment included a 50% chance of more-preferred activities being available (as in treatment), Ian selected the mixed-schedule context over both the rich and lean reinforcement conditions, affirming the notion that the mixed-schedule context was more reinforcing than the rich context, despite the decrease in the overall amount of more-preferred activities available in the mixed-schedule context. When the mixed-schedule context included only less-preferred activities, Ian began selecting the rich-reinforcement context, suggesting that preference in this analysis was not exclusively controlled by descriptions of the mixed-schedule context as a "mystery box".

Ian’s preference switched back to the mixed-schedule context once the 50% arrangement was reinstated.

These results suggest a possible treatment to address problem behavior related to transitioning from rich-to-lean schedules of reinforcement (or from more-preferred to less-preferred contexts). By including the unsignaled and probabilistic availability of more-preferred activities or items, the duration of pausing and number of steps taken when transitioning to a historically lean context of reinforcement were effectively decreased. These data support previous basic research suggesting that extended pausing does not readily occur during mixed-schedule arrangements that remove the signal predictive of less reinforcement (Williams et al., 2011).

This unsignaled and probabilistic treatment format lends itself to application during inescapable transitions such as sending children to bed, dinner, or the bathroom. For example, the context preceding bedtime may often be filled with rich reinforcement (e.g., TV time with snacks and high quality attention from parents) followed by a transition to the bedroom which is characterized by much leaner reinforcement (e.g., no TV or snacks and relatively brief attention via the bid goodnight). The proposed treatment for this common rich to lean transition may consist of incorporating a relatively rich reinforcement context in the bedroom (e.g., some extended and high quality interaction with parents with preferred books or toys) to be available following transitions on only some occasions and unpredictably.

It is important to note from these findings that the rich or lean value of a reinforcing context is not an inherent property of the context themselves, but value of a given context is instead determined by its relation to other available contexts. The continually evolving and relative nature of reinforcement was underscored in this study as the duration of pausing during the transitions from lean-to-rich increased with treatment for all three participants in comparison to transitions from rich-to-lean. Overall, there was a large positive difference in pausing when no treatment was in place (i.e., more pausing during rich-to-lean than lean-to-rich transitions) and a negative difference in pausing when treatment was introduced (i.e., less pausing during rich-to-lean than lean-to-rich transitions). Including unsignaled probabilistic reinforcement appears to have altered the value of the lean context, opening the door to future research on treatments that reduce the contrast between rich-to-lean transitions. For example, if increasing the difference in reinforcement between the rich and lean contexts exacerbates pausing, then inserting a moderate context may reduce the overall difference and subsequently reduce pausing. The preparation would then involve the child transitioning from rich-to-moderate-to-lean contexts in a more gradual process rather than the immediate rich-to-lean transition.

The preference for the mixed-schedule context was interesting because this context included less reinforcement than choosing only the more-preferred activities. In other words, if Ian chose the more-preferred activities he would receive them every time whereas choosing the mixed-schedule treatment resulted in the more-preferred activities half the time. Previous research has, however, provided examples from other preparations that show preference for unreliable reinforcement at the expense of maximizing reinforcer production (Lalli, Mauro, & Mace, 2000).

The outcomes of the treatment and preference analyses and those of Lalli et al. (2000) appear similar because they both involve children choosing contexts involving less programmed reinforcement. Lalli et al. explained their outcomes by referring to the stronger conditioning of cues related to reinforcement in the unreliable context. The controlling variables in the current study are less clear and probably different because there were no obvious cues in the mixed-schedule context that could have acquired value via conditioning. In the Lalli et al. arrangement, selections resulted in a cue being presented for 30 s before the programmed consequence. Depending on the color of the cue it either signaled the delivery of the reinforcer or no reinforcement. In our arrangement, the .5 probability of the more-preferred reinforcer being delivered was identical to Lalli et al.; however, no cues were included and the activities, whether more or less preferred, were delivered immediately following a selection. Preference for the mixed-schedule context seems more likely influenced by the unpredictability of the outcome in this context. Considering the strong commitment of teachers and behavior analytic practitioners to design predictable schedules for young children, especially those with autism (McClannahan & Krantz, 1999), in the context of these findings, additional research on the boundaries of preference for unpredictable over predictable transitions seems important. Teachers outwardly arrange predictable transitions by using picture schedules to signal each upcoming activity. However, if we are to assume that some of those activities are rich in reinforcement (e.g., recess, free time) and other activities are lean in reinforcement (i.e., homework time, clean up time), the problems during some of those transitions from rich-to-lean contexts will be exacerbated by including those picture schedules. In light of the recent findings, and precedence of basic research on transitions, these strong commitments to a predictable visual schedule should be modified to include some unpredictable "mystery" activities arranged throughout the day or the visual schedule should be entirely removed.

As it stands now, modifications to the commitment to predictable schedules may be warranted as previous research has found advanced notice (McCord et al., 2001), warnings (Wilder, Zonneveld, Harris, Marcus, & Reagan, 2007), and picture schedules (Waters, Lerman, & Hovanetz, 2009) to be ineffective in reducing problems related to transitions. This evidence is in addition to the current study suggesting that the predictable transitions are also less preferred than the unpredictable alternative. In fact, Everly, Holtyn, and Perone (2014) found that, when given the opportunity to turn a multiple- into a mixed-schedule, pigeons would escape stimuli correlated with lean schedules of reinforcement. These effects were enhanced when the lean schedule of reinforcement was preceded by a rich schedule suggesting that the signals may gain some aversive properties. The evidence from both basic and applied research therefore converge in support of reducing the predictability of upcoming schedule changes when they are predictive of a worsening.

General Discussion

Problem behavior related to transitions is a commonly reported concern of parents with children with or without a diagnosis of an intellectual disability. Current functional approaches to analyzing problem behavior during transitions (e.g., Wilder, Chen, Atwell, Pritchard, & Weinstein, 2006) have remained somewhat distinct from analyses of transitions from the basic laboratory due to the very different procedural arrangements. Rather than show whether pausing or problem behavior was maintained by particular reinforcers (e.g., escape or access to tangibles), this study showed that the problems during transitions may be occasioned by the contrast between an inescapable transition from a previous rich-reinforcement context and some sort of signaling stimulus indicating an upcoming lean-reinforcement context.

Researchers should consider applying this model while providing differential consequences to problem behavior during transitions to provide a more complete account of the variables controlling problem behavior during transitions (i.e., the contingency as well as the relational contexts for transition difficulties could be identified). In other words, the aversive properties of transitioning from rich-to-lean schedules may act as a conditioned establishing operation (EO) that increases the negatively reinforcing value of escaping from the upcoming transitions and this same EO may be absent when transitioning from lean to rich contexts. The responses evoked under rich to lean transitions may produce escape and come under control of its consequences. For example, if a child slams the door and hides in their room when told to come to the dinner table while playing video games, the first instance of this escape behavior may have been evoked by the contrast between the reinforcement itself (presuming of course that dinner is a reinforcer and of less quality than the video games). However, if the parent allows the child five more minutes of play, the escape behavior may now have contacted reinforcement and be maintained by different variables. This would be analogous to the preparations of a pigeon escaping the colored lamp correlated with lean reinforcement by pressing a key to turn it off and walking into the corner of the chamber (Everly et al., 2014). Regardless of the whether or not differential consequences are provided for problem behavior, pausing during transitions could be considered an operant evoked by the joint control of the previous and upcoming schedules of reinforcement with treatments centering on this assumption.

A possible limitation of the current study may be that the primary measures were of less severe problem behavior than that often reported in treatment studies, such as self-injurious or aggressive behavior. Due to parental reports of such behavior, these forms of problem behavior were measured; however, few of these types of behavior were observed during each analysis. On the contrary, an assessment that does not evoke severe problem behavior but does identify controlling variables for other problems during transitions may be advantageous. The assessment model described in the current study allowed for the reliable measurement of an existing problem and identified a viable treatment to improve behavior during transitions while escaping the programming of more definitively aversive contexts and exposure to dangerous and severe problem behavior.

Furthermore, we did not intend for the procedures to be specific to those diagnosed with severe behavioral disorders and could therefore encompass the ubiquitous concerns of transitioning all children to and from locations such as going to bed or back to classrooms after recess time. In these situations, pausing can disrupt schedules for parents or caregivers; therefore, transitions seem to be an important applied area of study, whether or not severe problem behavior is occasioned during the transition (for another example see Cote, Thompson, & McKerchar, 2005).

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Table 1

Demographic Information and Preferred Materials used in the Transitions Analyses

	Demographic information			Transitions analysis			
				Experiment 1		Experiment 2 and 3	
	Age	Diagnosis	Participation	Rich	Lean	Rich	Lean
Franco	4	PDD	Exp. 1, 2, 3	Coloring	Legos®	DVDs, Hot Wheels®	Lightning McQueen®
Johan	3	PDD	Exp. 1, 2, 3	Pretzels	Swedish Fish®	Hot Wheels®	String beads
Ian	6	ASD	Exp. 2, 3	--	--	DVDs, dinosaurs	Legos®
Duke	4	None	Exp. 2	--	--	DVDs, Legos®	Puzzles

Note. All participants were male. PDD refers to pervasive developmental disability. ASD refers to autism spectrum disorder. The 4-transition analysis was included in Experiment (Exp.) 1. The 2-transition analysis was included in Experiment 2 and 3.

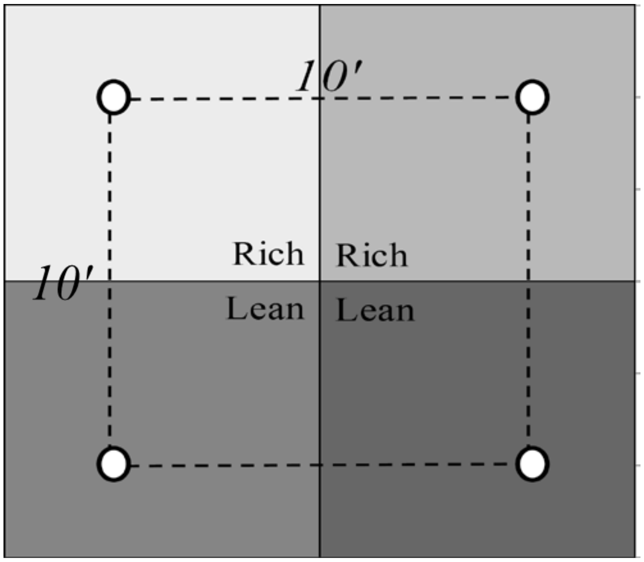

Figure 1. A diagram of the setting during Franco's analysis. The broken lines represent the shortest distance between each transition (around 10 feet across). Each quadrant is correlated with a specific set of rich or lean activities (circles) based on a previously conducted preference assessment.

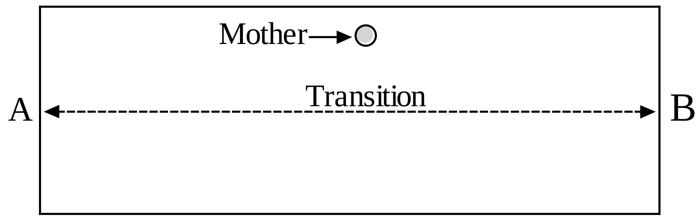

Figure 2. A diagram of Johan's arrangement during Study 1. Prompts were provided to transitions between the initial context (A) to the terminal context (B). The color of the sorting task in each reinforcement context was dependent on the randomly selected rich (FR 1 with more-preferred edibles) or lean (FR 5 with less-preferred edibles) schedule. At any point Johan could elope (included in the measures of pausing and steps taken during transitions) to his mother (filled circle) but his mother was instructed not to provide any attention or respond to bids from Johan.

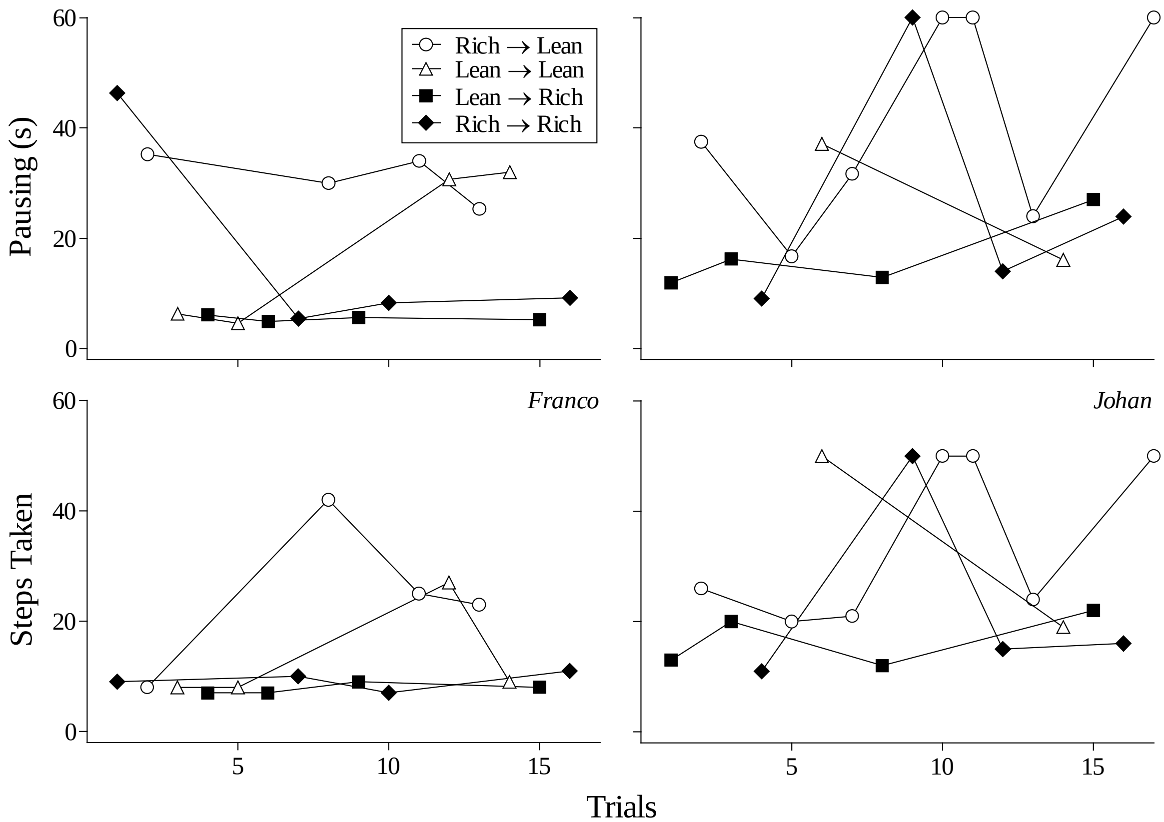

Figure 3. The top panels represent the duration of pausing for both Franco (left) and Johan (right) per transition trial. The bottom panels represent the frequency of steps taken per trial.

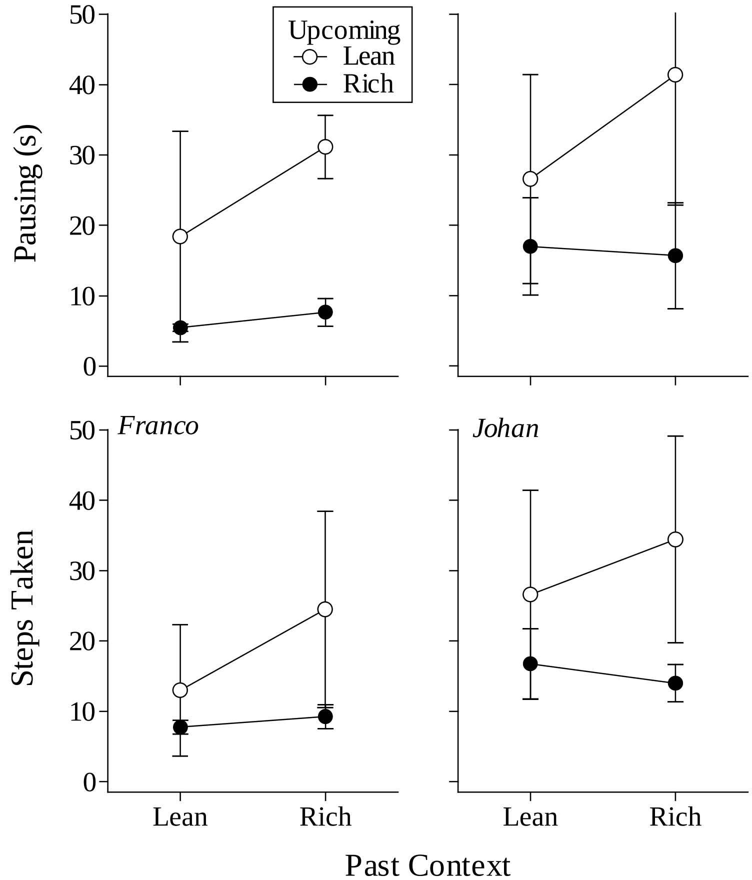

Figure 4. Depicted are the mean durations of pausing and frequency of steps taken in relation to the previously experienced context and transition to the upcoming context (top panels). Vertical lines represent standard deviation. Only data in which the participant completed the transition is included in these analyses.

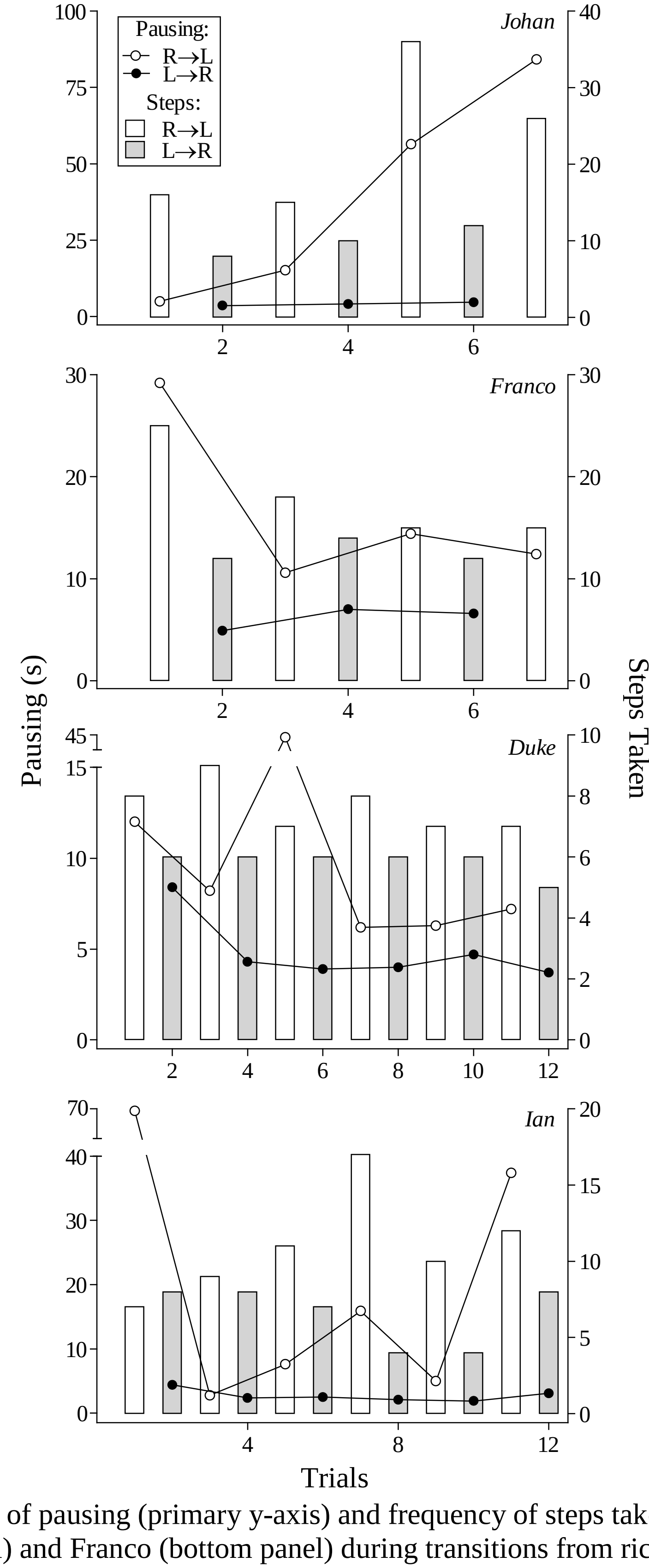

Figure 5. Durations of pausing (primary y-axis) and frequency of steps taken (secondary y-axis) for Johan (top panel) and Franco (bottom panel) during transitions from rich-to-lean (filled symbols) and lean-to-rich (open symbols) contexts.

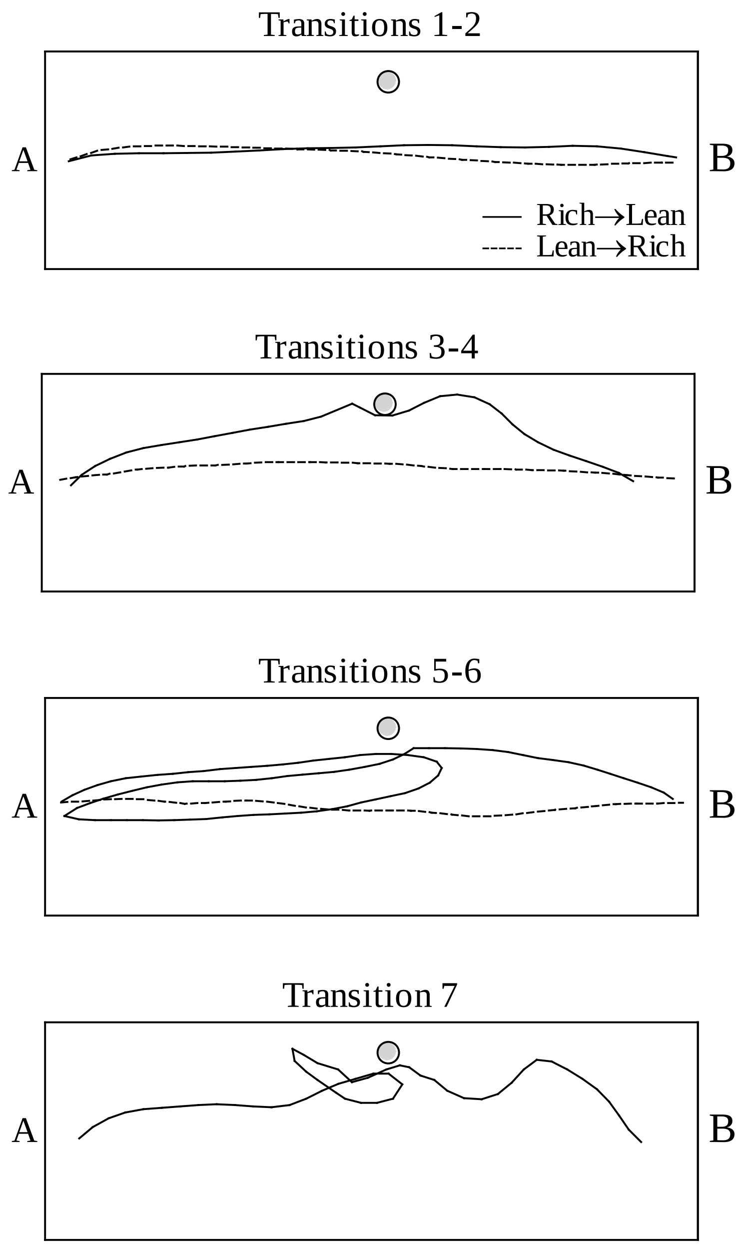

Figure 6. Meandering measurements for Johan during the 2-transition analysis. The solid line represents the actual path travelled during transitions from rich-to-lean contexts. The broken line represents the actual path travelled during transitions from lean-to-rich contexts. The closed circle represents the location of Johan's mother.

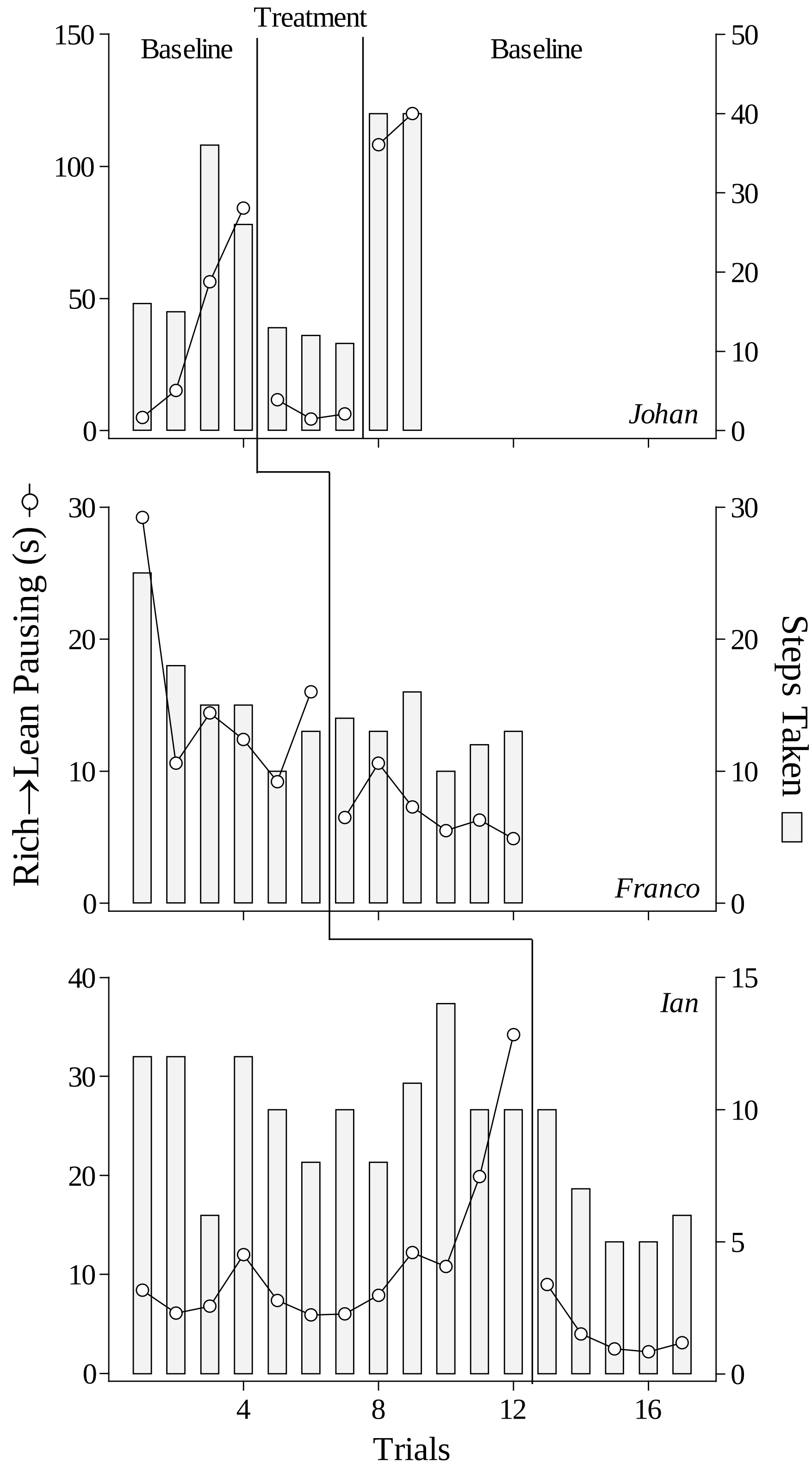

Figure 7. Durations of pausing (primary y-axis) and frequency of steps taken (secondary y-axis) for Johan (top panel) and Franco (bottom panel) during baseline and treatment phases across transition trials.

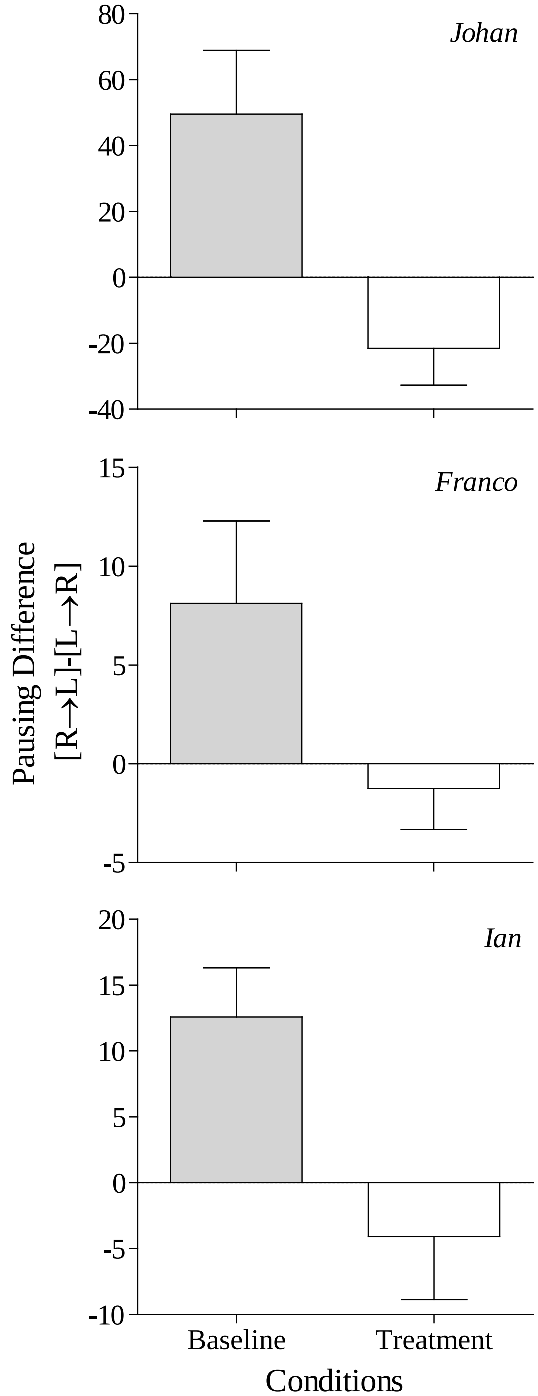

Figure 8. Difference in pausing duration (s) from relative rich-to-lean and lean-to-rich transitions for Johan (top panel), Franco (middle panel), and Ian (bottom panel) during the Baseline condition (filled bar) and Treatment (open bar) conditions.

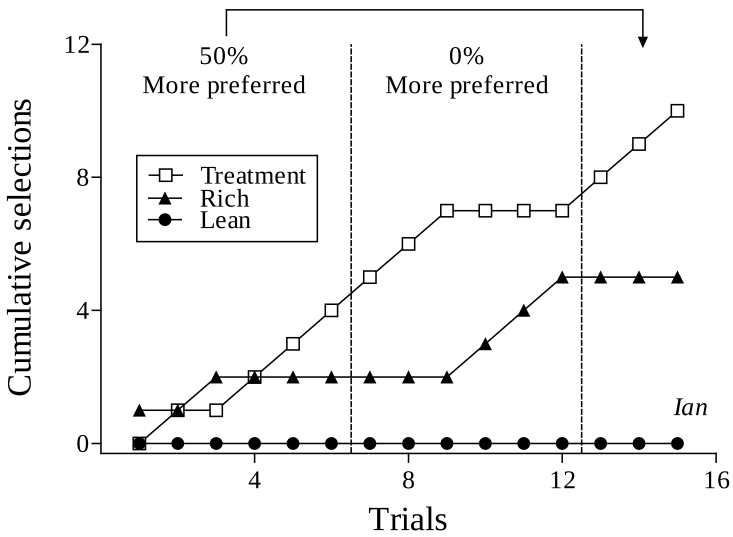

Figure 9. The results of Ian's concurrent chains preference assessment.