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Combined use of Delay Fading and Timeout to Reduce Severe Aggression and Disruption in a Child with Autism Spectrum Disorder

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Abstract

A functional analysis showed that severe aggression and disruption of a 9 year old boy with ASD and ADHD was primarily evoked by delayed access to preferred reinforcers (chocolate and a mobile phone video game). Problem behaviour was conceptualized as impulsive behaviour and a low tolerance to delayed reinforcement. A delay fading procedure was implemented that consisted of visually presenting the reinforcer to the child and setting a phone countdown timer. The timer was initially set at a brief delay interval and then gradually increased as tolerance to delay improved and low rates of problem behaviour were observed. A timeout procedure was also used for severe problem behaviour during periods outside the delay training sessions. Parents were trained to implement the procedures following demonstration of their effectiveness when implemented by behavioural therapists.

Keywords: ASD, ADHD, Delay fading, Timeout, Parent training

Introduction

Many studies have used various the functional analysis methodologies to identify the function of problem behaviour in individuals with disabilities. However, relatively few conceptualized problem behaviour as impulsiveness and a lack of self-control. Impulsiveness is defined as low tolerance to delayed reinforcement [1-4]. Humans also appear to engage in impulsive behaviour in a variety of situations and many problem behaviours have been discussed in terms of impulsivity and self-control, because those behaviours show a preference for immediate reinforcement over delayed and more beneficial outcomes [4,5].

Functional analysis identifies variables that influence the occurrence of problem behaviour and has become a hallmark of behavioural assessment [6]. One model of functional analysis manipulates antecedent events, also known as the A-B model [7]. The A-B model conceptualizes the antecedent event as a motivating operation (MO) that can evoke problem behaviour when it is presented [8]. Most applications of the A-B model alternate between various test conditions and a *control condition* and identification of behavioural function relies on a comparison of behaviour under test and control conditions.

There are a variety of intervention options when presentation of one or more MOs evokes problem behaviour. One intervention approach in such situations is based on the behavioural model of self-control [9,10]. The main goal of these interventions is to increased tolerance for delayed reinforcement by teaching individuals to wait for access to reinforcing events. The key feature of these interventions is delay fading which involves presenting the target MO and then gradually increasing the wait time to gain access the preferred positive or negative reinforcer [11-13]. Delay fading was used in conjunction with a countdown phone timer to indicate the predictability of reinforcer access [14].

and disruption presented by a boy with ASD and ADHD and to design evidence based treatment protocols that were shown to be effective and train the boy's parents to implement them with similar effectiveness. A combination of mass delay fading trails were used when teaching tolerance to delayed reinforcement and timeout from positive reinforcement when episodes of severe problem behaviour occurred outside training sessions and when the child left training sessions.

Method

Participant and Setting

Kevin was a 9-year-old boy diagnosed with autism spectrum disorder (ASD) and attention-deficit hyperactivity disorder (ADHD). His early age development was regular but at the age of two he started to show problem behaviour. At the time of the study he was taking medication (Depakine Chrono 150/0/300 mg, Concerta 18/0/0 mg). He had language delay, he used two-word utterances, had spontaneous vocal behaviour and three to four mands. His tact repertoire was about 100 words and his receptive language repertoire was approximately 50 words and phrases. He followed simple instructions and had developed imitative skills. He showed little interest in toys and functional play. He spent much of his time engaged in various problem behaviours.

Kevin was referred to an autism-centred clinic in Split Croatia by his parents for the assessment and the treatment of problem behaviour. His parents reported in a functional behavioural assessment interview that Kevin frequently engaged in several behaviours of significant concern to the family. He reportedly was also highly selective about the foods he eats and had a very restricted range of foods in his diet. A multiple stimulus without replacement (MSWO) preference assessment identified two potential reinforcers: chocolate and iPhone video games [15].

Assessment and treatment was conducted in an interdisciplinary clinic for children with ASD and related developmental disorders. Kevin attended five, 3-hour applied behaviour analysis (ABA) sessions per week conducted by two ABA trained special educators. Sessions were conducted by an early intervention specialist enrolled in a BCBA course with 16 years teaching experience in 4m square classroom with one table and 2 chairs and a variety of "safe" soft toys and educational materials in the room with small sensory play area.

Target behaviours, Data collection and Interobserver Agreement

Data were collected on following target behaviours: oppositional vocalizations (saying NO, uncooperative sounds), screaming (loud vocalizations typically characterized as a tantrum), disruption (ripping paper, kicking and throwing objects), aggression (hitting, pinching, biting) and self-injurious behaviour (biting his arm, hitting his head). An experienced data collector collected data using continuous count within 10-sec interval recording procedure. These data were converted into number per minute dependent measure.

To obtain a measure of interobserver agreement, videotape recordings were taken periodically and were independently scored by one research assistant. Each taped session was compared on a point-by-point basis with the data collected by the data collector during the session. Data were scored as being in agreement if the assistant scored occurrence of each target behaviour in the same interval as recorded by the primary data collector. Total number of agreements on each occurrence and non-occurrence of problem behaviour were divided by the total number of agreements plus total number of disagreements. Agreement was 100%.

Functional analysis

Based on the functional behavioural assessment interview, the clinic team designed several assessment conditions in order to determine which conditions his problem behaviour was sensitive to. Kevin's mother conducted the functional behavioural analysis (FBA) by presenting Kevin with several events that are known to motivate problem behaviour in individuals with ASD and intellectual disabilities [16]. These conditions are described below in the order they occurred and included easy and difficult tasks, low adult attention (diverted and divided), *restricted access* to preferred items, turn taking and a control condition (play with mother) that was absent environmental motivators for problem behaviour. No programmed consequences were arranged for problem behaviours. All FBA sessions lasted 5 min.

The *play* condition was the control or comparison condition. During these sessions, Kevin's mother interacted with him in a pleasant manner and no tasks or instructions were presented. In the *easy task condition*, Kevin was presented with colouring book and provided verbal prompts to continue the task during pauses in colouring. The restricted access condition began by providing Kevin with 2 min access to preferred games on an iPhone. After 2 min Kevin's mother said: "Give me back the phone. The game is over". This condition resulted in high rates of problem behaviour and was followed by the play condition until Kevin was calm and no problem behaviour was evident for at least 60 sec. Two variations of low adult attention were presented. Both conditions began with Kevin's mother interacting with Kevin in a pleasant manner for 2 min. In the *divided attention condition*, Kevin's mother said: "You can look at this book. I have to talk with the therapist." Kevin's mother then interacted with the therapist and did not interact with Kevin for the remainder of the session. The diverted attention condition was identical to the divided attention except that after interacting with Kevin, Kevin's mother read a book and did not interact with Kevin for the remainder of the sessions. The next session repeated the easy task condition. This was followed by the *difficult task condition* in which Kevin was presented with a relatively difficult academic task (math sheet). The last conditions tested whether Kevin was sensitive to being in control of an activity. In the *control condition*, Kevin was required to takes turns with his mother on a drawing task. This condition was also replicated with the therapist. Sixteen functional analysis sessions were conducted, each of which were 5 minutes in duration. Each session was separated by a 2 min period in which Kevin could move around room, but he didn't have access to reinforcers (chocolate and the iPhone).

Treatment Procedures

Delay tolerance training (parents not present): It was apparent from the assessment that Kevin could not tolerate any restrictions on his access to preferred items, so the treatment used was based on the behavioural model of self-control know as delay tolerance. Delay tolerance training was conducted with his preferred reinforcers (the iPhone and chocolate). The therapist sat across a table from Kevin, held the iPhone in front of him and set the timer on stopwatch giving instruction: "Kevin, wait!" The phone countdown timer was set and made visible to Kevin. The initial wait time was short (10 sec) and gradually increased to as high as 1 min as Kevin showed increased ability to wait without significant problem behaviours. This condition was replicated with chocolate with an initial wait period of 20 sec and faded up to 1 min. In the last four treatment sessions, Kevin was given a choice between immediate access to the iPhone or delayed access to chocolate. He reliably selected the larger delayed reinforcer and there were zero occurrences of problem behaviour and the wait time was faded to 3 min.

Delay tolerance training (parents present): Following several sessions without problem behaviour, Kevin's parents were introduced to the treatment room seated away from training table and sessions continued to be implemented by the therapist as described earlier. The initial delay period was 30-sec followed by 19 sessions at a 20-sec delay period due to high rates of problem behaviour. As problem behaviour reduced on the same day, 40 sessions were conducted with the wait period gradually increasing to 60 sec.

Delay tolerance training—parent training and implementation: The first three sessions were conducted by the initial therapist and the next two implemented by a new therapist. During these sessions, both parents were seated next to the training table. Following successful treatment, delay tolerance training was conducted by Kevin's mother and then later by Kevin's father. While parents implemented the intervention, the therapist gradually faded her physical proximity to the training table in an effort to transfer stimulus control to the parents. Following sessions were conducted by mother and later father. During the parent present procedure, therapist gradually moved away from the table where the treatment was conducted.

Timeout from positive reinforcement: Kevin engaged in tantrums including screaming and disruptive behaviour outside restricted access conditions [17]. Timeout is a negative punishment procedure in which an individual is removed from a place of relatively high reinforcement to a place of comparatively lower positive reinforcement contingent on occurrences of target problem behaviours for a specified period of time.

Two baseline sessions were conducted by the therapist without the parents being present. These began with the onset of tantrums

or disruption without a specific MO being presented to Kevin. The following timeout procedure was implemented by the therapist in a single session without the presence of the parents and then for two sessions with the parents present. During the last three sessions, the parents implemented the procedure in the presence of the therapist.

Contingent on tantrums or disruption, the therapist said, "Kevin, no tantrums" and simultaneously held Kevin by the torso and walked him to the timeout are and instructed him to sit in the timeout chair positioned in the corner of the treatment room. When Kevin attempted to leave the timeout chair, physical guidance was used to return him to the chair. During timeout blocking and avoidance were employed to prevent injury from aggression or self-injury. Kevin was praised during timeout for periods of remaining calm. After 30 sec of remaining calm, the therapist set the countdown timer for 2 min, made it visible to Kevin and said, "When the timer sounds, timeout is over". If Kevin engaged in tantrums or disruption during the 2-min period, the therapist reset the timer and repeated the above procedures.

Results

Figure 1 shows the results of Parent-Run Functional Analysis. Serious behaviour problems such as aggression and self-injury occurred almost exclusively during conditions in which access to an iPhone or chocolate occurred. Aggression did occur approximately one time per minute during the control with the therapist condition, indicating an insensitivity to turn taking and a preference to control the drawing activity. However, all problem behaviours occurred at very low rates when the turn taking activity was conducted by Kevin's mother. Serious behaviour problems at significant rates were not observed during the play and other test conditions.

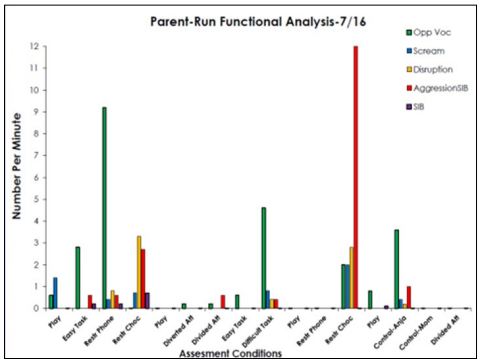

Figure 1: Problem behaviour per minute for the five target problem behaviours during each functional analysis condition.

Because restricted access was associated with the highest levels of problem behaviour, this condition was chosen for the treatment implementation. Figures 2, 3 and 4 show the results of delay tolerance training with restricted access to phone or chocolate with sessions conducted by the therapist. Intolerance to delay was evident in the first four of five sessions but was followed by zero problem behaviour during a gradual increase in the wait period over 20 session for the first day of treatment. When problem behaviours did occur, they were limited to oppositional vocalizations, screaming and disruption; no aggression or self-injury occurred. The second day of treatment problem behaviours returned at high rates during the first two sessions when access to the iPhone and chocolate restricted for short periods of time (Figure 3). During the third day of delay tolerance training few occurrences of problem behaviour occurred even when Kevin was offered a choice of immediate a less preferred reinforcer (phone) or 60 seconds delayed access to chocolate and later 120 and 180 seconds delayed reinforcer (Figure 4).

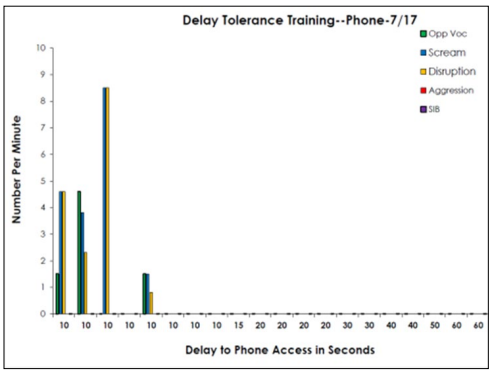

Figure 2: Problem behaviour per minute for the five target problem behaviours during delay tolerance training with the iPhone conducted by the therapist at different delay to reinforcement intervals.

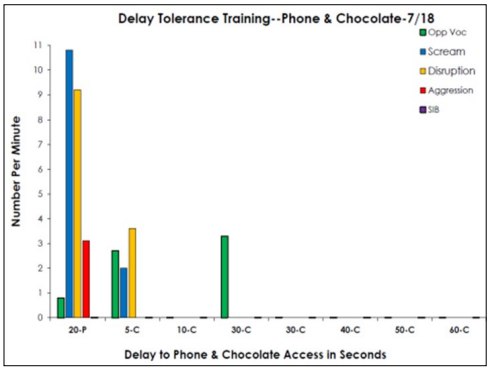

Figure 3: Problem behaviour per minute for the five target problem behaviours during delay tolerance training with the iPhone and chocolate conducted by the therapist at different delay to reinforcement intervals.

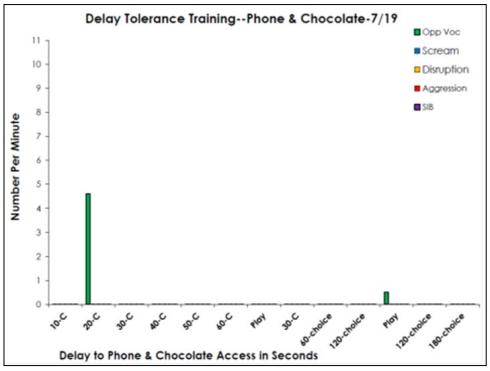

Figure 4: Problem behaviour per minute for the five target problem behaviours during delay tolerance training with the iPhone and chocolate conducted by the therapist at different delay to reinforcement intervals and with choice of immediate a less preferred reinforcer or delayed most preferred reinforcer.

On the fourth day of treatment, delay tolerance training continued to be implemented by the therapist with Kevin's parents present in the back of the treatment room. Figure 5 shows a dramatic increase in all target problem behaviour despite no change in treatment procedures This increase occurred for 27 straight sessions before problem behaviour began to abate during the next 30 sessions and eventually reduce to zero over multiple sessions (see Figures 6 and 7), Kevin became tolerant to delayed access to chocolate and we increased the time delay from 20 to 60 seconds.

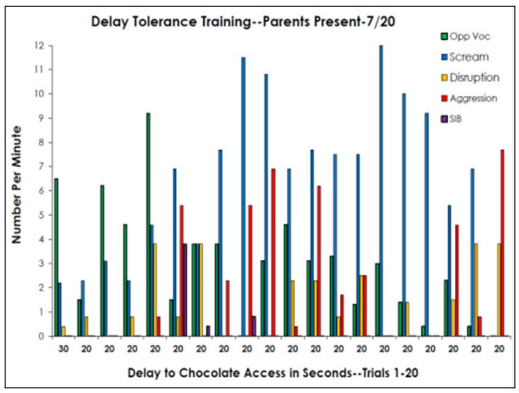

Figure 5: Problem behaviour per minute for the five target problem behaviours during delay tolerance training with 20 seconds time delay to reinforcement intervals with the parents present, sessions from 1 to 20.

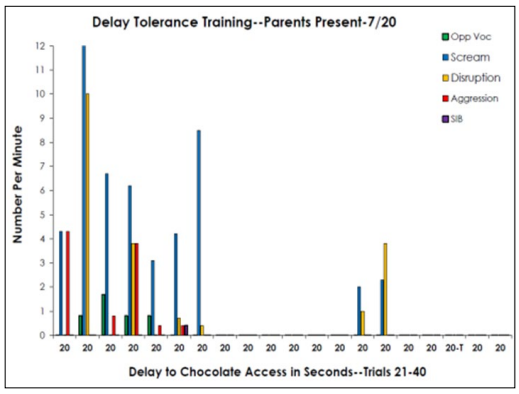

Figure 6: Problem behaviour per minute for the five target problem behaviours during delay tolerance training with 20 seconds time delay to reinforcement intervals with the parents present, sessions from 21 to 40.

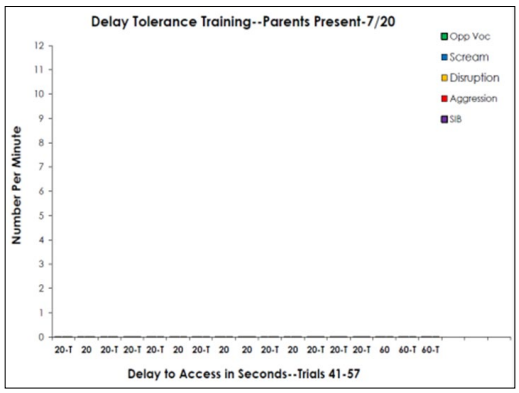

Figure 7: Problem behaviour per minute for the five target problem behaviours during delay tolerance training with increasing 20 to 60 seconds time delay to reinforcement intervals with the parents present, sessions from 41 to 57.

Figures 8 through 14 show Kevin's behaviour when the parents were trained and implemented the treatment during the last three days of treatment. Kevin's mother and father implemented the treatment while a therapist blocked aggression, clothing removal and attempts to leave the treatment area. Treatment results were variable but overall Kevin was responsive to delay tolerance training when implemented by the mother and father with notable exception seen in Figure 10 and 12. On every treatment occasion, treatment was not discontinued until Kevin successfully waited without severe problem behaviour for a minimum of five consecutive sessions.

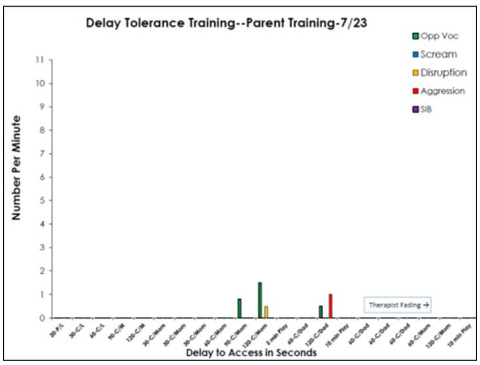

Figure 8: Problem behaviour per minute for the five target problem behaviours during delay tolerance training with the chocolate conducted by the therapists and parents at different delay to reinforcement intervals and with therapist fading.

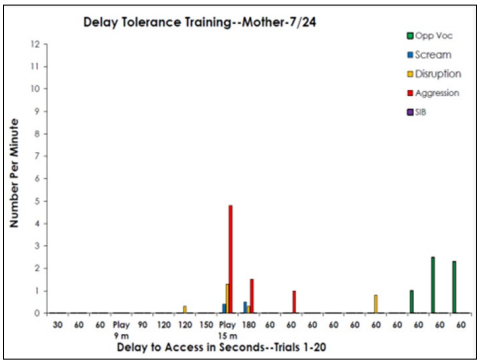

Figure 9: Problem behaviour per minute for the five target problem behaviours during delay tolerance training with increasing 30 to 60 seconds time delay to reinforcement intervals and play condition conducted by mother, sessions from 1 to 20.

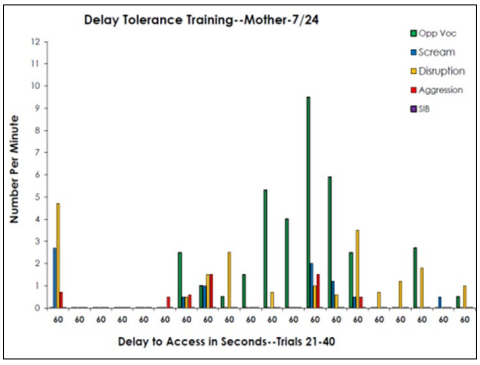

Figure 10: Problem behaviour per minute for the five target problem behaviours during delay tolerance training with 60 seconds time delay to reinforcement intervals conducted by mother, sessions from 21 to 40.

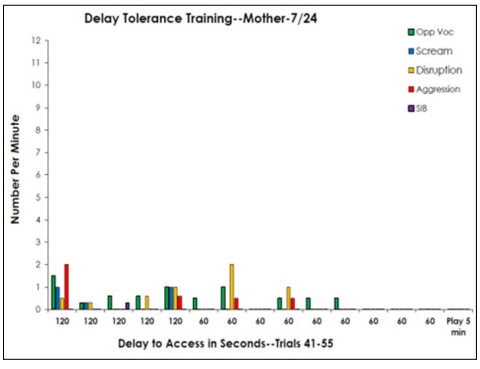

Figure 11. Problem behaviour per minute for the five target problem behaviours during delay tolerance training with decreasing 120 seconds time delay to 60 seconds time delay to

reinforcement intervals conducted by mother, sessions from 41 to 55.

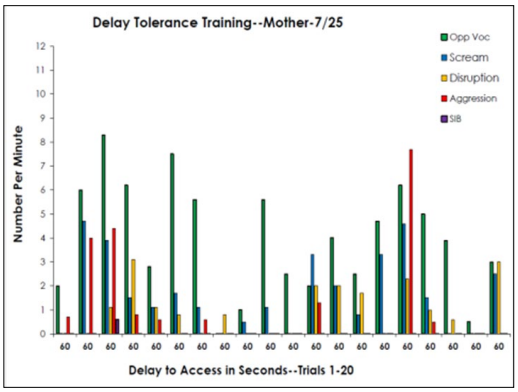

Figure 12: Problem behaviour per minute for the five target problem behaviours conducted next day during delay tolerance training with 60 seconds time delay to reinforcement intervals conducted by mother, sessions from 1 to 20.

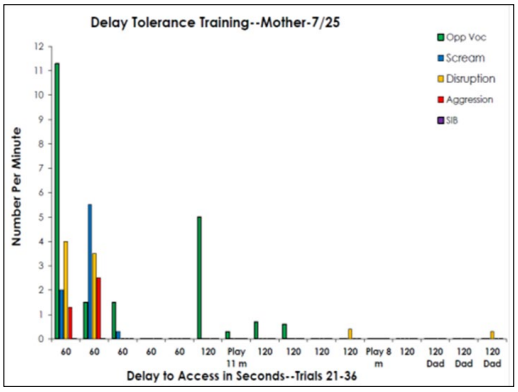

Figure 13. Problem behaviour per minute for the five target problem behaviours during delay tolerance training with increasing 60 seconds time delay to 120 seconds time delay to reinforcement intervals with play condition conducted by mother and father, sessions from 21 to 36.

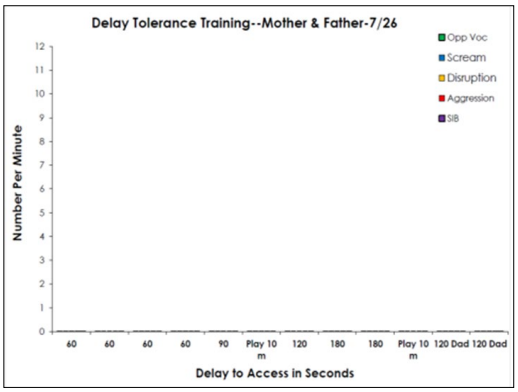

Figure 14: Problem behaviour per minute for the five target problem behaviours during delay tolerance training with increasing 60 seconds time delay to 180 seconds time delay to reinforcement intervals with play condition conducted by mother and father.

Finally, Figure 15 presents the results from the evaluation of the timeout procedure. Tantrums during the two baseline sessions conducted by the therapist occurred for 30 to 32 min. There were zero minutes of tantrums when the therapist implemented the timeout procedure alone but tantrums increased during the procedure when the parents entered the treatment room for the first session but returned to zero during the second timeout session. Parents implemented the timeout procedure for three consecutive sessions and trantrums gradually reduced to zero.

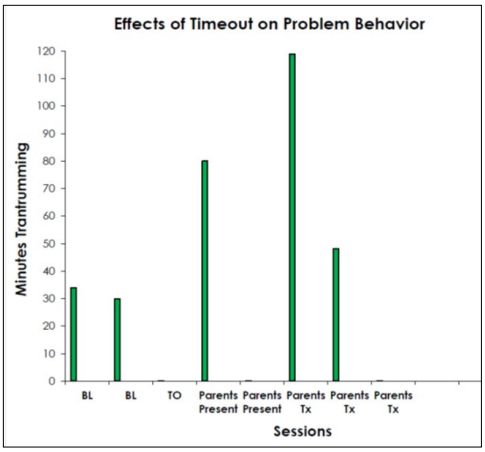

Figure 15: Minutes of tantruming during baseline sessions and the results of timeout procedure with the therapist alone and with the parents present.

Discussion

Our clinic team designed a functional analysis of multiple severe problem behaviours presented by a 9-year old boy diagnosed with ASD and ADHD that was implemented by the child's mother. Functional analysis results showed that Kevin was highly sensitive to restricting his access to two preferred reinforcers, iPhone video games and chocolate. Other functional analysis conditions were not correlated with high levels of problem behaviour. Based on these findings, two treatments were designed to reduce problem behaviours. The first intervention was a delay tolerance training procedure implemented during several consecutive sessions at a table. The second intervention was timeout from positive reinforcement that was used when Kevin engaged in problem behaviour outside of the discrete trials. Both interventions were first evaluated by the therapist, followed by training parents to implement the procedures and treatment implementation by first Kevin's mother and then his father. Both interventions were quickly effective when implemented by the therapist and were reduced to zero. Treatment implementation by Kevin's mother required more sessions to become effective which occurred after several days of implementation. Both parents participated enthusiastically with the treatment procedures and were pleased with the nature of the procedures and their outcomes.

During the functional analysis, Kevin began to engage in severe problem behaviour almost immediately after his mother removed the iPhone or would not provide additional chocolate when Kevin manded for it. The immediacy of Kevin's adverse response appeared impulsive. Consequently, Kevin's problem behaviour was conceptualized as impulsive behaviour and indicated a lack of self-control. Rachlin and Green (1972) developed a behavioural model of self-control using a concurrent chained schedule of reinforcement [10]. Pigeons were presented with an initial link that consisted of a choice between pecking two white keys that differed only by their left-right position on the operant panel. Both right keys arranged a fixed ratio 25 (FR 25) schedule of reinforcement. Completing the schedule requirements resulted in a darkening of both keys and, after a specified time interval, the presentation of one of two terminal links. The terminal link presented after completing the left initial link requirement was a red key and a green key providing pigeons a choice between the two keys. A single peck on the green key immediately resulted in 2 sec access to grain. A single peck on the red key resulted in a 4-s delay followed by 4 sec access to food. The behavioural

model of self-control conceptualizes pecks on the green key to be impulsive behaviour because the pigeon is forfeiting twice as much food in exchange for immediate reinforcement. Pecks on red key are viewed as self-control and a tolerance for delayed reinforcement to obtain a preferred reinforcer. This finding has been replicated by several basic research studies with nonhumans and humans [9,10, 18-20].

There have been several clinical applications of the behavioural model of self-control. For example, Vollmer et al. found that tolerance for delayed reinforcement for children showing impulsive preferences for smaller immediate reinforcement over larger delayed reinforcement could be increased substantially using timers to signal the duration of reinforcer delay [21]. This study shows that the adverse effects on problem behaviour of a variety of aversive events such as restricted access and reinforcement delay can be minimized when environmental events are made predictable. Similarly, Rubia et al. used timer in the treatment to reduce problem behaviour and increase tolerance to delayed reinforcement [22]. Again, Vollmer et al. signalled delayed reinforcement with a timer or hand gesture to indicate when a functional communication response would be reinforced [13,14,22].

The present clinical study was based on this literature and was aimed at teaching Kevin to tolerate delayed reinforcement time using a countdown timer. The wait period for reinforcement was gradually increased as Kevin showed a tolerance for delayed reinforcer access. In some sessions, the delay interval was faded downward when Kevin engaged in severe aggression or self-injury at a certain delay interval in order to regain control over his problem behaviour.

A timeout from positive reinforcement intervention was added to the treatment protocols. Timeout was used when severe problem behaviour occurred outside the context of delay tolerance training because of the severity of Kevin's behaviour and the risks of injury he posed to his younger brother and parents. Kevin had good relationships with his parents, marked by frequent pleasant interactions, thus differential reinforcement for appropriate behaviour (DRA) was available in conjunction with timeout, although DRA was not systematically arranged during the study.

Although the present study resulted in clear functional analysis findings and effective reductions of problem behaviour during both treatments, the study has some notable limitations. First, evaluation of delay tolerance training and timeout was done using an A-B design which lacked experimental control. Thus, the finding here should be interpreted with caution, although the present findings are consistent with several published studies employing similar procedures. A second limitation is that I was unable to obtain adequate follow-up data when the treatments were implemented at home and in the clinic. Kevin lived three hours from the clinic which interfered with systematic follow-up and long-term systematic treatment. Future studies should evaluate these interventions with an experimental design and make practical arrangements for follow-up and long-term treatment [23,24].

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