Effects of a Preferred Stimulus and Mother's Attention on Infant Behavior During Tummy Time

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Published online: 11 November 2014
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Abstract “Tummy time” is an activity for infants to develop muscle tone; however, it often evokes crying and non-compliance. The current study investigated two interventions for an infant to a) increase elevated head behavior, and b) decrease negative vocalizations. The study compared the effects of a preferred stimulus with or without maternal attention on infant behaviors during tummy time. The addition of maternal attention produced more positive outcomes:

- The science of behavior analysis can be used to treat a broad range of socially significant behaviors like infant behavior during tummy time.
- Preference assessments can be used with infants to identify potentially reinforcing stimuli.
- The continuous provision of a preferred stimulus during tummy time may help infants to increase positive behaviors and decrease problem behaviors.
- Parent attention may have an added benefit to a treatment package for typically developing infants.

Keywords Infant behavior · Tummy time · Preferred stimulus · Parent attention

Behavior analysis yields powerful interventions that can be used to change a broad range of important human behaviors across all ages. For example, Kadey and Roane (2012) used a behavior analytic intervention to increase important infant behaviors during tummy time. Tummy time is an activity in which an awake infant is placed in a prone position. Pediatricians recommend tummy time because this facilitates

motor development and reduces skull deformities (Graham 2006; Persing et al. 2003). Despite its reported positive outcomes, parents sometimes have difficulty implementing tummy time because of infants’ problem behavior (e.g., crying) during this activity.

To address this, Kadey and Roane (2012) used the continuous provision of a preferred stimulus to improve an infant’s tummy time behavior. The researchers positioned a video screen above the infant’s head, played a video during tummy time, and measured the infant’s head elevation and negative vocalizations (i.e., crying). With intervention, the infant’s negative vocalization decreased to zero and the time the infant raised her head increased substantially. In addition to tummy time intervention, a number of behavior analysts have demonstrated that contingent music, parental attention, and tangible stimuli can increase positive infant behaviors that replace challenging behaviors (Larson and Teodoro 1990; Thompson et al. 2007).

The present study directly replicated Kadey and Roane (2012)’s tummy time intervention and extended it by evaluating the intervention with and without parental attention. Evaluating parental attention is a logical extension because parents are present during tummy time and non-contingent attention may have an added benefit to tummy time outcomes. The study was conducted with Alex, who was a 14-week-old typically developing male infant. For tummy time, Alex was placed on a polyester mat by the wall of the living room. The first author and the mother conducted two 1-min sessions per day and separated each session by at least 10-min. To begin, the first author conducted single stimulus engagement preference assessment (SSE; Hagopian et al. 2001) and measured the duration of engagement with stimuli (e.g., books, pictures). This assessment revealed that an auditory sensory book produced the longest eye gaze for Alex and this toy was used during intervention.

Two sessions of baseline measured the duration of Alex’s elevated head and negative vocalization behavior. Elevated

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head consisted of Alex's head not being in contact with the mat. Negative vocalizations included crying and whining. During baseline, Alex's mother placed him in a prone position on the mat, said "Tummy time", and sat in front of Alex holding a white sheet of paper 60 cm (first observation) and 30 cm (second observation) above Alex's head. The white sheet of paper served as a control for holding an object above Alex's head. Alex's mother did not provide praise or attention during baseline. Figure 1 displays the result of the study. During baseline, Alex elevated his head during 12 % of the sessions and engaged in negative vocalizations during 99 % of the sessions. These data confirm the mother's report of low levels of elevated head and high levels of crying during tummy time.

At this point, Alex's mother asked to terminate baseline because Alex's negative vocalizations were stressful to the mother. Two treatments were compared during intervention. During the preferred stimulus intervention, sessions were conducted identical to baseline, but Alex's mother held the auditory sensory book 30 cm above Alex's head instead of the sheet of paper. She activated the book so that it made noise for the duration of the session. During the second intervention, the mother held the preferred stimulus and continually praised Alex for the duration of the session. The introduction of the treatment condition (see Fig. 1) showed a drastic increase in levels of elevated head and a drastic decrease in negative vocalizations for both of the treatments (with and without the mother's attention), thus replicating the findings of Kadey and Roane (2012). During the continuous provision of a preferred stimulus with no attention, on average, Alex elevated his head for 68 % of a session and engaged in negative vocalizations during 29 % of a session. Sessions that added the mother's verbal attention resulted in higher levels of elevated head ($M=87\%$) and lower levels of negative vocalizations ($M=13\%$). There was variability and overlap in the respective data paths. The data for negative vocalizations were less variable, and the data paths were more discriminable.

Overall, treatment that included the mother's attention produced higher levels of elevated head and lower levels of negative vocalizations. In this manner, this study extended previous research on infant behavior during tummy time. The findings of the present study also confirm the efficacy of social praise as part of a treatment package (e.g., Larson and Teodoro 1990; Thompson et al. 2007). In the current study, maternal attention was provided non-contingently and, paired with a preferred stimulus, led to improved infant behavior during tummy time.

The implications of increasing the time infants spend in tummy time are significant. A longitudinal study demonstrated that infants who spend more time in a prone position meet gross motor milestones (e.g., rolling over and crawling) earlier than children who spend less time in a prone position (Kuo et al. 2008). Interventions that increase positive infant

behaviors during tummy time are likely to reinforce the parent behavior of providing tummy time opportunities, which can have positive outcomes on the infant's development.

Alex's mother and grandmother completed social validity questionnaires. The grandmother rated all goal, procedure, and outcome statements with "Strongly Agree" or "Agree." The mother, who conducted baseline and treatment sessions, rated all statements as "Strongly Agree," with two exceptions. She responded "Neutral" about the ease of implementing the intervention and regarding whether her infant was happy when he was able to lift his head. In addition to the social validity outcomes obtained through questionnaires, the mother influenced how the study was conducted. The original intention was to conduct a reversal design similar to Kadey and Roane (2012). However, after experiencing the initial baseline sessions, the mother objected to conducting several baseline measures, including a return to baseline. Baseline sessions were very stressful for the mother because, as the data show, Alex cried during the majority of the sessions. This raises procedural issues that practitioners should be sensitive to. Alex's mother agreed to an alternating treatment comparison of two tummy time interventions because both were likely to improve Alex's behavior and she confirmed on the social validity questionnaire that she would recommend these interventions to other mothers.

To determine the generality of the finding here and the utility of the intervention more broadly, future researchers could evaluate the interventions presented here as well as other potential interventions using alternating treatment designs. It is unknown if attention alone would produce similar outcomes to attention plus the preferred stimulus. Future replications and extensions will refine our understanding of the effects of different interventions on infant behavior during tummy time as well as demonstrate whether the results obtained here have external validity. Presently, there is very little research on promoting positive tummy time behavior. The current study added a small amount of data by replicating previous research, and the data suggest that non-contingent maternal attention plus a preferred stimulus resulted in positive changes in this infant's tummy time behavior.

Detailed Method

Participant, Setting, and Materials

Alex was a 14-week-old typically developing infant at the beginning of the study. He was a full-term infant within the normal range of birth weight (i.e., 6 lbs. 5 oz.). The mother reported that Alex's cognitive, motor, and physical development was typical for infants of his chronological age, according to the child's pediatrician. The mother was recruited through an e-mail posted on a local mothers' e-mail group.

Fig. 1 The graphs displays percent duration of Alex's elevated head (*top panel*) and negative vocalizations (*bottom panel*)

Alex participated because his mother reported high levels of crying and low levels of lifting his head off the floor during tummy time.

All sessions took place in the living room of Alex's home. The mother placed a polyester mat (80 cm by 90 cm) near the wall of the room and Alex on the edge of the mat. She ensured that all the basic needs (food, clean diaper) were met for Alex before the observations. Two observations occurred per day. Each observation occurred in the morning and consisted of 1-min sessions (determined based on Alex's age and stamina). Each 1-min session was separated by a 10-min break. During breaks, Alex's mother held him or placed him in a supine position on the mat to rest. During the SSE, the experimenter presented six items that were chosen in collaboration with Alex's mother. The items included: a video of ABC songs, a Play-a-Song® book, a mirror, wee gallery picture cards, a painting, and a Bright Starts™ auditory sensory book (Teethe & Read). Additional materials included a Flip camera to record all sessions, a tape measure, and a blank sheet of paper (21.6 cm by 27.9 cm).

After treatment ended, Alex's mother and grandmother completed social validity questionnaires. The questionnaire

contained statements about the acceptability of goals, procedure, and outcomes, and statements were rated on a 5-point scale.

Dependent Variables

The dependent variables were durations of head elevation and negative vocalizations. The experimenter recorded head elevation when no part of Alex's head was in contact with the mat or his arms. Negative vocalizations occurred when Alex engaged in crying or whining. The experimenter used a stopwatch to record duration for both target behaviors in seconds. For elevated head, the experimenter started the stopwatch when Alex's head was not in contact with the mat and stopped the stopwatch when his head touched the mat or his arms. For negative vocalizations, the experimenter started the stopwatch when Alex began crying or whining and stopped the stopwatch when Alex stopped crying or whining. The experimenter calculated the percentage of the time Alex elevated his head and engaged in negative vocalizations by dividing the cumulative duration by 60 s and by multiplying by 100.

An independent observer watched 33 % of the sessions via videotape. The experimenter calculated the percentage of agreement for each session by dividing the shorter duration by the longer duration and multiplying by 100. The average interobserver agreement was 90 % for elevated head (range, 83 % to 96 %) and 89 % for negative vocalizations (range, 75 % to 100 %).

Procedure

The experimenter began by conducting a SSE (Hagopian et al. 2001) to determine Alex's most preferred item. The experimenter presented each potential item to Alex for 30 s and measured the duration of his eye gaze to the item. Alex looked at the auditory sensory book for 25.7 s, and this book served as the preferred stimulus in subsequent conditions.

All baseline and treatment sessions followed similar procedures to those described by Kadey and Roane (2012). Sessions began with Alex's mother saying, "Tummy time" while placing Alex "in a prone position with both hands in contact with the floor under [his] upper torso" (p. 396). During all observations, the mother and experimenter were in close proximity to Alex to intervene in the event of safety issues, which did not arise during any sessions.

During baseline, no objects were within sight or reach, and the mother sat in front of Alex facing him. The mother provided no attention or verbal praise to Alex during baseline. In the first baseline session, the mother held the blank sheet of paper 60 cm above his head as described in Kadey and Roane (2012). After the first baseline, the paper was placed 30 cm above Alex's head to ensure the stimulus was in his field of view.

Following baseline measurement, an alternating treatment design was used to evaluate the effects of two treatments on Alex's head elevation and negative vocalizations. The order of treatments was randomized using random numbers obtained at www.randomizer.org.

Both treatment conditions were conducted in the same manner as baseline except that the paper stimulus was replaced with the preferred stimulus and the mother's social behavior was manipulated. The experimenter implemented

two treatments: (1) the mother continuously provided verbal attention (e.g., social praise) during a session, and (2) the mother provided no verbal attention during a session. In both treatment conditions, the mother held the auditory sensory book 30 cm above Alex's head and manipulated the book to make sound.

Treatment Integrity

The experimenter collected treatment integrity data during all sessions. The experimenter recorded whether the mother followed all components correctly (e.g., S^D to begin session, holding stimulus, provide or not provide attention). Integrity was 83 % and 100 % during baseline and ranged from 97 % to 100 % for treatments with and without the mother's attention, respectively.

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