Effects of Activation of Preferred Stimulus on Tummy Time Behavior of an Infant with Down Syndrome and Associated Hypotonia

E. Amanda Boutot¹ · Samuel A. DiGangi²

Published online: 23 February 2018
© Association for Behavior Analysis International 2018

Abstract

Infants with Down syndrome often have low muscle tone (hypotonia) and need activities designed to increase muscle tone (e.g., tummy time). However, no study has examined the effects of strategies designed to increase of tummy time for this population. The current study investigated activation of a preferred toy as a strategy to increase head lifting during tummy time for a 5-month-old with Down syndrome and associated hypotonia. The intervention was successful and is a promising early strategy for addressing hypotonia in infants with Down syndrome.

- Infants with Down syndrome often have associated hypotonia, or poor muscle tone.
- “Tummy time” is widely described as an important activity for motor development in early infancy.
- Activating preferred stimuli during tummy time increased head lifting in an infant with Down syndrome and hypotonia.
- Activation of a preferred stimulus is an easy intervention that parents can use to enhance tummy time.

Keywords Down syndrome · Tummy time · Infants · Hypotonia · Preferred stimulus · Preference assessment

In the USA, the prevalence of Down syndrome is 1 in 800 live births and is “the most common identifiable cause of intellectual and developmental disabilities” worldwide (Skotko & Tenenbaum, 2016, p. 739). In addition to cognitive and developmental concerns, an oft-cited issue with individuals with Down syndrome is hypotonia, or low muscle tone (Skotko & Tenenbaum, 2016). Hypotonia can be seen from very early in infancy, often resulting in difficulties with sucking, feeding, as well as other fine and gross motor difficulties. Many infants with Down syndrome are “late to achieve early motor milestones, including grasping, rolling, sitting, standing, walking, sucking, babbling, and speech” as a result of hypotonia (Chu & Barlow, 2016, p. 3).

“Tummy time” is a procedure recommended for infants to increase muscle tone in early development (Graham, 2006). Tummy time refers to the practice of placing an infant in a prone position on their stomach and encouraging an elevated head position. This practice is designed to aid in development

of the head, neck, and shoulder strength and to “normalize motor milestone acquisition” (Jennings, Sarbaugh, & Payne, 2005, p. 5). In fact, several states recommend tummy time for infants under 6 months of age in order to improve motor development (Slining, Neelon, & Duffey, 2014).

Researchers have noted two limitations in the implementation of tummy time to improve motor development. First, parents are not often informed of or do not fully appreciate the importance of tummy time (Jennings et al., 2005), and as such may leave their infants in a supine position more often than is recommended. When this happens, infants are at risk for delayed motor development, including rolling over, creeping and crawling, as well as plagiocephaly (i.e., flattened back of head) (Jennings et al., 2005; Kadey & Roane, 2012). Second, when infants are positioned in a stomach-down prone position (i.e., tummy time), they may find it aversive and react with crying (Kadey & Roane, 2012) or lying their heads on the ground. The infant’s distress may then suppress parents’ use of tummy time with their infants to avoid the infant’s cries (Kadey & Roane, 2012).

Two previous behavior analytic research studies have focused on increasing appropriate behavior and decreasing inappropriate behavior during tummy time. Kadey and Roane (2012) evaluated whether access to preferred stimuli increased head elevation and decreased crying during tummy

✉ E. Amanda Boutot
eb15@txstate.edu

¹ Texas State University, San Marcos, TX, USA

² Arizona State University, Tempe, AZ, USA

time. The researchers played a video during tummy time and observed a decrease in negative vocalizations and an increase in head elevation for a 7-month old typically developing infant. Ortega and Fienup (2015) extended the findings of Kadey and Roane (2012) with a 3-month old typically developing infant by determining whether parent attention added additional value to the use of preferred stimuli. Head elevations increased and negative vocalizations decreased in both conditions; however, the “with parent attention” condition produced greater results for both dependent variables.

Families of infants with Down syndrome need easy to implement interventions that can address hypotonia and prevent or minimize motor delays. The current study evaluated the effects of noncontingent preferred stimuli activation during tummy time for an infant with Down syndrome and associated hypotonia. In addition, the infant’s mother was included as an implementer of the procedure.

Method

Participant and Setting

Dominic was a 5-month-old male Caucasian infant with physician-diagnosed Trisomy 21 and associated hypotonia. He was born via c-section at 34-week gestation with no perinatal complications, the fraternal twin to a neurotypical sister. Prior to intervention, Dominic was assessed using the Cognitive Assessment of Young Children (CAYC, Langley, Fewell, & Maddox, 2010). Reliability on the CAYC (i.e., coefficient alpha, test-retest, and coder difference) exceed .90 (Langley et al., 2010). Validity studies (i.e., content description, criterion-prediction, construct-identification) indicate viability as a general screening instrument (Langley et al., 2010). Dominic scored at the 27th percentile with a cognitive ability index score of 91 and age equivalent of 3 months. Dominic’s scores can be interpreted as “average” (90–110) per the CAYC test manual. His twin sister was also assessed and scored at the 47th percentile with a cognitive ability index score of 99 and an age equivalent of 5 months. Dominic’s physical therapist and physician had both recommended to his mother that tummy time was important due to hypotonia. However, his mother reported that he had difficulty holding his head up and usually just laid his head down on his arms or the floor. However, Dominic did not fuss or cry when placed on his stomach. Sessions took place in the family home, in a large play room with a couch, coffee table, television and stand, and assorted infant toys. For all sessions, Dominic was placed on a blanket in the center of the floor. Sessions took place after the morning nap and after being fed and diapered to ensure he was well-rested and comfortable.

Design, Procedures, and Measurement

The effects of preferred stimuli activation were evaluated using a reversal design (i.e., ABAB, BAB) to compare baseline and activation of preferred stimuli. Each condition lasted 2 min in duration and was videotaped for scoring purposes. All experimental sessions occurred on a single day. The sessions were conducted in immediate succession for evaluation one (i.e., researcher implementation) and evaluation two (i.e., parent implementation). A 25-min break occurred between the two evaluations. During this break, Dominic laid on his back, sat in his mother’s or the researcher’s lap, and engaged with toys other than those used for the intervention. The purpose of the break was to prevent fatigue from tummy time.

Preference Assessment Prior to intervention, Dominic’s preference for specific toys was assessed by observing his reactions to specific stimuli when presented in a single stimulus format (Pace, Ivancic, Edwards, Iwata, & Page, 1985). Stimuli were designated as “preferred” or “not preferred” based on whether or not Dominic engaged in any two (2) of the following: (a) looked at the object without interruption for at least 5 s, (b) smiled and laughed or cooed while looking at the object, and/or (c) kicked his legs or waved his arms while looking at the object. Three toys were identified as preferred for Dominic (i.e., a plastic pig that “oinked” when squeezed, a light up musical mirror toy snail, a spinning/popper toy). All three toys had an auditory and/or visual component that could be activated by adult manipulation (i.e., squeezing the pig, rocking the snail, or pushing the plunger of the popper toy). During the intervention, the toys were interspersed and changed out when Dominic showed signs of satiation (i.e., looking away for more than 5 s, no more smiles, or feet-kicking while watching the toy).

No Toy (A) Condition The preferred toys were out of Dominic’s line of sight and no toys were within reach. The researcher (i.e., evaluation one) or his mother (i.e., evaluation two) remained next to Dominic on the floor, providing noncontingent attention (speaking to or touching him) but gave no contingent attention based on head position.

Toy (B) Condition The researcher or Dominic’s mother placed the preferred toy 6–12 in. in front of Dominic and activated the toy noncontingently throughout the entire session, regardless of whether his head was up or down.

The dependent variables were head elevation, defined as anytime that Dominic’s face was at a 45° angle or above, and head down behavior, defined as lower than a 45° angle for more than 1 s (noted as a “head bob”). The total number of seconds spent in “head down” and “head elevated” were recorded for each 2-min session. Prior to coding behaviors, two researchers scored video footage together for fidelity training

until there was a 100% inter-rater agreement on “head elevated” and “head down” behavior.

To establish interobserver agreement (IOA), 55% of sessions were scored independently by the second author, who was trained in the research protocol. Total agreement was calculated by dividing the smaller number of total seconds by the larger and multiplying the sum by 100. The average IOA for the head elevated position was 98%, with a range of 93–100%. The average IOA for the head down position was 91%, with a range of 67–100%.

Results and Discussion

The head down percentage duration was almost always an exact reciprocal of head elevated so only head elevated data are reported here. During evaluation one (i.e., experimenter implemented; see top panel of Fig. 1a), the no toy condition resulted in Dominic’s head being elevated an average of 70% of the time (range, 58–77%). During intervention with the toy, Dominic’s head was elevated an average of 97% of the time

(range, 94–100%). During evaluation two (i.e., parent implemented; see bottom panel, Fig. 1b), the no toy condition resulted in head elevated an average of 55% of the time (range, 43–67%). During the toy intervention Dominic’s head was elevated an average of 99% of the time (range, 98–100%).

This study investigated the effects of preferred toy activation during experimenter implemented and parent implemented tummy time with a 5-month old with Down syndrome and associated hypotonia. Dominic’s head was elevated for greater duration during times when the toys were activated by either adult compared to when he was near an adult not manipulating toys. Dominic’s mother was easily taught to activate the preferred toys by observing the researcher during the first evaluation and minimal in vivo coaching. Noncontingent activation of preferred toys proved superior to noncontingent attention from either the mother or experimenter in eliciting head elevation for Dominic. These results are similar to previous studies indicating that preferred stimuli can increase appropriate tummy time behavior for typical infants (Kadey & Roane, 2012; Ortega & Fienup, 2015); however, unlike in previous research, mother’s noncontingent attention did not appear to

Fig. 1 The figure depicts the percentage of each 2-min session in which Dominic elevated his head above a 45° angle when the researcher (top panel) (a), or parent (bottom panel) (b) activated a preferred toy during tummy time or no toy was present

impact tummy time behavior in the current study. That is, Dominic raised his head more during toy activation than during noncontingent attention from his mother.

A few limitations are worthy of note. First, the entire analysis was conducted in a single day without replication on other days. Second, each condition was conducted as a single probe rather than to a stability criterion. Nevertheless, the findings support prior published literature on tummy time by extending the findings to an infant with Down syndrome and hypotonia. There are several implications for practice. First, early interventionists charged with increasing successful tummy time for infants with hypotonia might explore the use of preferred, adult-activated toys to increase head elevation. Second, parents can be taught how to use activated toys to increase head elevation during tummy time. Finally, professionals interested in applying behavior analysis with infants may find value in using a single stimulus assessment, though future studies would need to demonstrate that the identified preferred items produce better intervention effects than the non-preferred items. Future research could incorporate more robust research designs (i.e., phases conducted to stability), recruit a greater number of participants, younger infants, and examine the effects over a longer span of time.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflicts of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent was obtained from all individual participants included in the study.

References

- Chu, S. Y., & Barlow, S. (2016). A call for biomechanics to understand hypotonia and speech movement disorders in Down syndrome. *Advances in communication disorders*. Telangana India: Avid Science Publications.
- Graham, J. M. (2006). Tummy time is important. *Clinical Pediatrics*, 45, 119–121. <https://doi.org/10.1177/000992280604500202>.
- Jennings, J. T., Sarbaugh, B. G., & Payne, N. S. (2005). Conveying the message about optimal infant positions. *Physical & Occupational Therapy in Pediatrics*, 25(3), 3–18. https://doi.org/10.1080/J006v25n03_02.
- Kadey, H. J., & Roane, H. S. (2012). Effects of access to a stimulating object on infant behavior during tummy time. *Journal of Applied Behavior Analysis*, 45, 395–399. <https://doi.org/10.1901/jaba.2012.45-395>.
- Langley, B. M., Fewell, R., & Maddox, T. (2010). *Cognitive assessment of young children*. Austin: Pro Ed.
- Ortega, R., & Fienup, D. M. (2015). Effects of preferred stimulus and mother's attention on infant behavior during tummy time. *Behavior Analysis in Practice*, 8, 66–69. <https://doi.org/10.1007/s40617-014-0032-1>.
- Pace, G. M., Ivancic, M. T., Edwards, G. L., Iwata, B. A., & Page, T. J. (1985). Assessment of stimulus preference and reinforcer value with profoundly retarded individuals. *Journal of Applied Behavior Analysis*, 18, 249–255. <https://doi.org/10.1901/jaba.1985.18-249>.
- Skotko, B. G., & Tenenbaum, A. (2016). Down syndrome. In I. L. Rubin, J. Merrick, & D. E. Greydanus (Eds.), *Health care for people with intellectual and developmental disabilities across the lifespan* (pp. 739–750). New York: Springer. https://doi.org/10.1007/978-3-319-18096-0_63.
- Slining, M. M., Neelon, S. E. B., & Duffey, K. J. (2014). A review of state regulations to promote physical activity in child care. *Journal of Behavioral Nutrition and Physical Activity*, 11(1), 39–46. <https://doi.org/10.1186/s12966-014-0139-3>.