Blue Light Covers Increase Stereotypy and Decrease On-Task Behavior for Students with Autism

Sacha T. Pence¹ · Reginna Wagoner² · Claire C. St. Peter³

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Abstract

Some recommended strategies for individuals with autism spectrum disorder (ASD) are not empirically based. The purpose of the study was to evaluate effects of blue light covers on levels of stereotypy and on-task behavior. Four male children with ASD who engaged in repetitive behavior participated. Placing light covers over the classroom's fluorescent lights relative to normal classroom lighting did not improve on-task behavior or stereotypy.

Keywords Autism · Light covers · Problem behavior · Sensory integration · Stereotypy

Individuals with autism spectrum disorder (ASD) may engage in repetitive or rigid behavior either by avoiding or appearing to seek out specific textures, smells, sounds, or visual stimuli. Some individuals consider these responses to indicate sensory-processing deficits that contribute to behavioral and functional performance problems (Case-Smith, Weaver, & Fristad, 2015). As a result, strategies to promote appropriate processing of sensory information, including sensory-integration therapies, are commonly recommended to address behavioral concerns with individuals with ASD (Linderman & Stewart, 1999).

Sensory-integration therapy typically involves the combination of specific activities to address the individual's sensory needs and could include wearing a weighted vest, brushing the skin, swinging, or sitting on a ball (Barton, Reichow, Schnitz, Smith, & Sherlock, 2015). In recent years, researchers have begun to systematically investigate sensory-integration therapy. For example, Sniezky and Zane (2015) found that deep pressure did not decrease stereotypy for one participant and a sensory diet (deep pressure, deep compression, joint

compressions, and squeezes) did not decrease stereotypy with a second participant. Similarly, Reichow, Barton, Neely Sewell, Good, and Wolery (2010) evaluated weighted vests with three young participants with ASD by comparing a weighted vest, vest with no weights, and no vest. The weighted vest did not increase engagement with activities. Barton et al. (2015) reviewed 30 studies and found inconsistent findings across studies, with seven studies suggesting positive effects from sensory-based treatments for children with disabilities. However, the authors warned that these studies should be interpreted with caution due to methodological issues or failure to exclude alternative explanations.

Despite the limited efficacy data, interventions based on sensory integration are historically popular. Green et al. (2006) surveyed parents on the number and types of procedures, programs, or approaches used in the treatment of their children with ASD. Approximately 71.4% of parents reported either currently using sensory integration (38.2%) or using it in the past (33.2%). On the contrary, 59.1% of parents reported currently using applied behavior analysis (36.4%) or using it in the past (22.7%). One such sensory-integration therapy in Appalachian schools consisted of changing the wavelength of fluorescent lights in classrooms serving children with ASD.

Attempts to reduce the potentially aversive properties of fluorescent lights have resulted in commercially available products, many of which have not been scientifically evaluated. The light covers evaluated in the current study were available in either blue or white heat-resistant fabric panels and were advertised in catalogs targeted toward professionals that work with people with ASD. The second author was a teacher

✉ Sacha T. Pence
sacha.pence@drake.edu

¹ Department of Leadership and Counseling, Drake University, Des Moines, IA 50311, USA

² Monongalia County Schools, Morgantown, WV, USA

³ Psychology Department, West Virginia University, Morgantown, WV, USA

in a special-education classroom who was approached by the school occupational therapist (OT) with the catalog depicting the light covers. The OT notified the teacher that she had ordered the light covers to help address the stereotypy and off-task behavior of the students in the classroom. At this time, the second author was receiving behavior-analytic training and supervision by the first and third authors and requested assistance to evaluate the light covers. The purpose of the current study was to evaluate the effects of blue light covers on levels of stereotypy and on-task behavior with children with ASD.

Method

Participants and Setting

Four male children who had diagnoses of ASD and engaged in repetitive behavior participated. Owen and Roger were 9 years old. James was 10 years old and diagnosed with comorbid oppositional defiant disorder. Austin was 7 years old. All participants communicated vocally using full sentences.

Observations took place during the participants' regularly scheduled morning and afternoon class periods in their special-education classroom with the second author. Observations rotated between participants based on their availability; the light covers were added or removed simultaneously across all participants based on visual analysis of trends and levels across all participants. There were no windows in the classroom; seven fluorescent lights in the ceiling provided light. The door that opened into the main hallway remained closed for the duration of instruction. Furnishings in the classroom consisted of a kidney-shaped table where the teacher provided direct instruction, six individual desks arranged in a rectangle where students worked on independent tasks, an independent-work station, a reading area with a chair, two computers, and a small round table.

Data Collection and Interobserver Agreement

All observations were 20 min in duration. We conducted one or two observations with each individual per day, 2 or 3 days per week. During each observation, observers collected data on stereotypy and on-task behavior using 10-s momentary time sampling on paper-and-pencil data sheets. Experimenters converted data to a percentage of intervals engaging in stereotypy and on-task behavior by dividing the total intervals in which the target behavior occurred by the total number of intervals in the observation and multiplying the proportion by 100.

We defined repetitive behavior individually. Owen's motor stereotypy was defined as body rocking, hand flapping, hand/finger waving/flicking (not including greeting and

departing), twirling hair, running fingers through his hair, thumping/pounding on his chest with an open or closed hand, and clapping hands. Roger's vocal stereotypy was repeating questions, statements, or sounds/noises more than two times consecutively with less than 5 s between instances. Roger's motor stereotypy was defined as twirling strings or other objects and shaking his head side to side (at least 2.5-cm movements). James's motor stereotypy was defined as body rocking or body twisting; hand flapping/waving (not including greeting and departing); tapping materials, hands, or feet; bouncing his body up and down in his seat or while standing; or kicking or swinging his legs back and forth more than 15 cm. Austin engaged in nail biting (tips of one or more nails at or past the plane of the lips) and nose picking (one or more fingers past the plane at the end of the nostril). We defined on-task behavior as the participant's body and gaze oriented toward materials or the teacher, pencil in hand or near paper (during writing tasks), or asking/answering questions relevant to the ongoing task.

We calculated interobserver agreement (IOA) by dividing the number of 10-s intervals with agreement by the total number of intervals during the observation. An agreement was recorded when both observers scored the occurrence or nonoccurrence of an event during that interval. The ratio was converted to a percentage by multiplying by 100. Data were collected for the purposes of calculating IOA on 38.4% of sessions across all conditions. Mean IOA was 92% (range 73.5%–100%) for on-task behavior and 96% (range 82.4%–100%) for stereotypy.

No Covers

During the no-covers phase, the seven fluorescent lights were on and uncovered. The special educator asked students to work on various activities in centers. Centers rotated approximately every 15 min and included multiple centers with maintenance work (e.g., activities for reading comprehension and math), educational programming on the computer, listening to auditory books, and one-to-one instruction with the special educator. One student was present at a center at a time. The specific activity varied from observation to observation (e.g., different math worksheets, different auditory books); however, independent tasks were similar in difficulty across all observations.

We collected data on stereotypy and on-task behavior during independent center activities consisting of maintenance work. Observations were paused across participants and phases when students rotated to auditory books, the computer, and one-to-one instruction with the teacher. We paused observations during the computer and auditory books because these activities can provide competing stimulation with stereotypy, which could increase variability of stereotypy unrelated to the intervention. We paused sessions during one-

to-one instruction because it included dense schedules of demands, praise, and prompts and to reduce the extent to which any changes in teacher behavior influenced student responding. Observations resumed after students returned to a center consisting of independent work.

We asked the teacher to prompt students consistently throughout all observations. The teacher sometimes provided a prompt to a student to resume an activity if the student was off task for a prolonged period or was engaging in nontargeted problem behavior. We did not collect data on teacher prompts during each observation. However, the teacher rarely provided prompts to students in the independent activity centers during observations.

Blue Light Covers

The school OT purchased the blue light covers and recommended that the special educator use them in her classroom to create a calming environment and to reduce stereotypy and increase on-task behavior. The blue light covers were 0.6 m × 1.2 m heat-resistant fabric panels and were “tranquil blue” (color described on the package). The panels had sewn-in magnets that were used to affix the blue fabric panels over standard ceiling fluorescent-light fixtures. During the light-covers condition, a blue light cover remained fastened over each of the fluorescent lights in the classroom.

We collected data during independent work as described in the no-covers phase. Similar to the no-covers phase, the teacher attempted to keep her prompting consistent and rarely provided prompts to students during the targeted activities. If the students asked about the light covers, the teacher stated that she had added some covers for the lights that would be up for a few days.

Results

Austin (Fig. 1, first graph) engaged in moderate to high levels of on-task behavior and low levels of stereotypy during the no-covers phase. When the light covers were introduced, on-task behavior initially decreased slightly and then increased across the phase to no-covers levels, and stereotypy remained at similar levels. On-task behavior increased to high levels and stereotypy decreased to near-zero levels when the light covers were removed. When the light covers were restored, on-task behavior decreased across the phase; stereotypy initially remained low but increased during the last observation.

Roger (Fig. 1, second graph) had decreasing levels of on-task behavior to moderate levels and low levels of stereotypy during the no-covers phase. On-task behavior initially increased when the light covers were added but decreased across the light-covers phase to no-covers levels. Stereotypy gradually increased across the light-covers phase. When the light

covers were removed, on-task behavior increased to high levels and stereotypy initially increased but decreased to low levels across observations. During the final light-covers phase, on-task behavior decreased to moderate levels and stereotypy remained at similar levels to the no-covers phase but gradually increased across the phase.

Owen (Fig. 1, third graph) engaged in high levels of on-task behavior and moderate levels of stereotypy. During the light-covers phase, levels of on-task behavior were variable with decreased levels initially and at the end of the phase; stereotypy initially decreased but increased to higher levels across the phase. When the light covers were removed, on-task behavior increased to stable, high levels and stereotypy decreased to low levels. During the final light-covers phase, on-task behavior decreased across observations; stereotypy initially remained at similar levels but increased at the end of the phase.

James (Fig. 1, fourth graph) engaged in moderate levels of on-task behavior and stereotypy during the no-covers phase. During the light-covers phase, on-task behavior decreased across observations; stereotypy initially remained at similar levels but increased at the end of the phase. When the light covers were removed, on-task behavior increased to high levels and stereotypy decreased to low levels. When the light covers were restored, on-task behavior decreased to moderate to low levels and stereotypy increased to moderate levels.

Discussion

This study was conducted to allow a special educator (the second author) to evaluate potential effects of light covers recommended by the OT to create a calming environment. By using an A-B-A-B design, we were able to systematically evaluate the effects of the light covers on the behavior of four children with ASD. The addition of light covers did not have positive effects on levels of on-task behavior or stereotypy. On the contrary, on-task behavior decreased and stereotypy increased with the addition of the light covers for all four participants. In particular, Owen and James consistently engaged in reduced on-task behavior and higher levels of stereotypy when the light covers were present compared to when they were absent.

One limitation of the current study was that we did not collect data on teacher prompts. Although prompts rarely occurred across phases, future researchers evaluating sensory-integration interventions should collect data on teacher responses that could influence the intervention. Another potential limitation is the number of sessions conducted during each phase. Given the overlap of data paths for some participants (e.g., Austin) between phases, additional observations could have helped determine the degree to which the light covers affected levels of stereotypy and on-task behavior. Finally, we

Fig. 1 Percentage of 10-s intervals with stereotypy and on-task behavior across no-covers (NC) and light-covers (Lights) observations for Austin, Roger, Owen, and James

did not explicitly return to the no-covers phase at the end of the study; however, the teacher removed the light covers after the final observation for the study and did not use them for the remainder of the year.

Individuals with ASD and their families may be at risk for exposure to interventions that lack empirical evidence (Kodak & Carroll, 2017). This study adds to previous literature using single-subject designs to evaluate sensory-based interventions with individuals with ASD. Similar to previous investigations, modifying sensory input (i.e., changing the sensory input

provided by fluorescent lights) did not produce therapeutic effects with these participants.

Although sensory-based interventions may have no effect on behavior, there are still costs associated with using such interventions. Regardless of their efficacy, interventions require financial and time resources, including costs to train staff and to purchase materials. The costs of purchasing light covers for all of the fluorescent lights in the classroom in the current study was about \$400. Interventions also require time that could be used for other evidence-based programming.

Behavior analysts should engage in evidence-based practice, which involves making decisions based on the best available evidence, clinical expertise, and client values and context (Slocum et al., 2014). Behavior analysts can encounter situations within their practice where professionals make recommendations that are supported by little to no evidence. Under such circumstances, behavior analysts should refer to the *Professional and Ethical Compliance Code for Behavior Analysts* (hereafter, “the Code”) outlined by the Behavior Analyst Certification Board (2017). As behavior analysts, we must rely on professionally derived knowledge based on science (Code 1.01) to guide our practice and recommendations. Furthermore, the Code (2.0) outlines the responsibility behavior analysts have to operate in the best interest of their clients, including the obligation to advocate for and educate the client about effective and scientifically supported treatments.

Although there are situations in which the behavior analyst can make the case against a recommendation that does not have empirical support, there are times when a multidisciplinary team may decide to incorporate that intervention into a client’s programming. If the behavior analyst is unfamiliar with the intervention, he or she should conduct a literature review and consult with colleagues and mentors. Assuming that the intervention will not harm the individual or the individual’s progress and that the team (or family) decides to implement the intervention, the behavior analyst should obtain written consent to evaluate the intervention and communicate relevant information to the team. Behavior analysts can approach recommendations for non-empirically supported interventions by engaging in evidence-based practice, using the existing literature and their clinical expertise, and systematically evaluating effects that the intervention has on target responses. By operationally defining target responses, collecting data, and using experimental designs (e.g., A-B-A-B, alternating-treatments design), behavior analysts can determine if a recommendation is beneficial, has no effect, or is countertherapeutic for their clients.

Implications for Practice

- Individuals with ASD and their families may be at risk for interventions that lack empirical evidence.
- Behavior analysts are ethically obligated to rely on the scientific method and make judgements based on that method.
- Behavior analysts should use data to determine if interventions are therapeutic.
- Behavior analysts should use experimental designs to evaluate if an intervention is beneficial, has no effect, or is countertherapeutic.

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 Informed consent was obtained for all participants included in this study.

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References

- Barton, E. E., Reichow, B., Schnitz, A., Smith, I. C., & Sherlock, D. (2015). A systematic review of sensory-based treatments for children with disabilities. *Research in Developmental Disabilities*, 37, 64–80. <https://doi.org/10.1016/j.ridd.2014.11.006>.
- Behavior Analyst Certification Board. (2017). *Professional and ethical compliance code for behavior analysts*. Retrieved from <https://www.bacb.com/ethics/ethics-code/>
- Case-Smith, J., Weaver, L., & Fristad, M. A. (2015). A systematic review of sensory processing interventions for children with autism spectrum disorders. *Autism*, 19, 123–148. <https://doi.org/10.1177/1362361313517762>.
- Green, V. A., Pituch, K. A., Itchon, J., Choi, A., O’Reilly, M., & Sigafoos, J. (2006). Internet survey of treatments used by parents of children with autism. *Research in Developmental Disabilities*, 27, 70–84. <https://doi.org/10.1016/j.ridd.2004.12.002>.
- Kodak, T., & Carroll, R. A. (2017). Substantiated and unsubstantiated interventions for individuals with ASD. In J. Matson (Ed.), *Handbook of treatments for autism spectrum disorder* (pp. 17–40). Cham, Switzerland: Springer.
- Linderman, T. M., & Stewart, K. B. (1999). Sensory integrative-based occupational therapy and functional outcomes in young children with pervasive developmental disorders: A single-subject study. *American Journal of Occupational Therapy*, 53, 207–213. <https://doi.org/10.5014/ajot.53.2.207>.
- Reichow, R., Barton, E. E., Neely Sewell, J., Good, L., & Wolery, M. (2010). Effects of weighted vests on the engagement of children with developmental delays and autism. *Focus on Autism and Other Developmental Disabilities*, 25, 3–11. <https://doi.org/10.1177/1088357609353751>.
- Slocum, T. A., Detrich, R., Wilczynski, S. M., Spencer, T. D., Lewis, T., & Wolfe, K. (2014). The evidence-based practice of applied behavior analysis. *Behavior Analyst*, 37, 41–56. <https://doi.org/10.1007/s40614-014-0005-2>.
- Sniezky, C. J., & Zane, T. L. (2015). Investigating the effects of sensory integration therapy in decreasing stereotypy. *Focus on Autism and Other Developmental Disabilities*, 30, 13–22. <https://doi.org/10.1177/1088357614525663>.