A TECHNOLOGY-AIDED APPROACH TO TEACHING PARENTS TO CREATE A SAFE INFANT SLEEP SPACE

by

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ABSTRACT

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Sleep-related death during infancy is the most preventable form of infant death. The American Academy of Pediatrics (AAP) published recommendations for safe infant sleep; however, parents still report frequent use of dangerous infant sleep practices. An online computer program was developed to investigate whether parents could be taught to create safe sleep environments using a computerized behavioral skills training (BST) package that includes instructions, modeling, rehearsal, and feedback. Using a pre- and post-test design, the present study compared the relative effectiveness of three conditions; Instructions Only (standard of care), the computerized BST package completed once, and the computerized BST package completed until 100% mastery was observed on the post-test (BST-M). Additional pre- and post-tests assessed parents' ability to identify sleep risks in three pictures to assess generalization of skills learned. First they provided free-responses, and then they used a checklist based on the AAP's safe sleep guidelines. Overall, participants demonstrated significant improvements from pre- to post-test across all treatment conditions on the creation of a safe sleep environment and on the free-response identification of risks in three sleep environments. Performance did not significantly differ between the three treatment groups, suggesting various potential interventions to teach highly educated and health literate parents how to create a safe sleep environment.

Keywords: bed-sharing, behavioral skills training, computer training, infant sleep, prevention, SIDS, sleep, technology

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A Technology-Aided Approach to Teaching Parents to Create a Safe Infant Sleep Space

Annually in the United States, approximately 3,700 infants die suddenly and unexpectedly [Centers for Disease Control and Prevention (CDC), 2017]. Sudden unexpected infant death (SUID) is the abrupt and unanticipated death of an infant younger than one year of age (CDC, 2017). SUID includes deaths attributed to sudden infant death syndrome (SIDS), in which a thorough investigation is completed and a clear cause of death cannot be determined (43%); unknown causes of infant death where an investigation was not completed (32%); and deaths from accidental suffocation and strangulation in bed (25%; CDC, 2017). Other sleep-related environmental components are known to increase the risk of SUID (described in the next section). These other sleep-related environmental components suggest deaths related to unsafe sleep environments are likely much greater than the 25% captured by the CDC's estimate of deaths due to accidental suffocation and strangulation in bed.

AAP Recommendations

Based largely on epidemiological studies, the American Academy of Pediatrics (AAP) created specific recommendations for reducing known SUID risks (AAP, 2005; 2011; 2016). These guidelines may be categorized as those related to the sleep environment and those that are unrelated to the sleep environment. The guidelines unrelated to sleep environment include recommendations on the importance of infant immunization, breastfeeding; avoiding cigarette exposure; "tummy time" (placing the infant on his or her stomach when awake and supervised to strengthen the muscles in the neck and promote development of motor skills); and the role of health care professionals, the media, and researchers in promoting protective safe sleep behaviors. The sleep environment recommendations from the 2011 report were adapted into 13 brief instructions for this study. At the time this study was developed, the 2016 guidelines had not yet been released; however, the differences are slight and for the purpose of this study, they are negligible. Section 1 of Appendix A shows the instructions used for this study. These instructions include ensuring the infant is placed to sleep on a flat and firm surface, separate from a caregiver or other infants/children; making certain that blankets, pillows, and toys are not in the sleep area; ensuring the infant does not have anything covering his or her head and is not overheated; and that there are no choking or strangulation hazards in the sleep environment. The AAP (2011; 2016) only provided recommendations that were empirically-supported (i.e., consistent results from at least two well-designed case-controlled studies, meta-analyses, or systematic reviews). For example, the AAP cites over 10 articles supporting one recommendation: "Keep soft objects and loose bedding out of the crib to reduce the risk of SIDS, suffocation, entrapment, and strangulation" (AAP, 2011, p. 1033).

Sleep environment risks may be mitigated through targeted interventions (e.g., National Center for Health Statistics, 2011; Salm Ward & Balfour, 2015). Despite the broadly disseminated AAP recommendations within the health care community, sleep-related infant death is still rising (CDC, 2017; Colson et al., 2005). There are several possible reasons why the AAP recommendations are not having their intended impact. Parents could receive insufficient or inaccurate information and/or they could misunderstand or disregard the information, favoring personal preferences instead (e.g., Chung, Oden, Joyner, Sims, & Moon, 2012; Colson et al., 2005; Gaydos, Blake, Gazmararian, Woodruff, Thompson, & Dalmida., 2015; Ward & Balfour, 2015).

Many parents simply are not aware of the AAP recommendations. For example, 30% of pediatricians report never discussing sleep arrangements with parents and, consequently, certainly do not specifically discuss the full AAP guidelines (Eron et al., 2011). Gaydos and colleagues (2015) found that lack of information about the safe sleep guidelines was one of the main reasons for mothers' non-adherence. Even when information on safe sleep is sought, parents may receive inaccurate information. Chung (2012) found that much of the information easily accessible online about safe infant sleep is inaccurate or inconsistent with the AAP guidelines.

In cases when accurate safe sleep information is provided, some mothers still do not follow the recommendations because they do not understand the rationale behind them (Gaydos et al., 2015; Salm Ward, 2015). Without a clear understanding, parents may disregard the AAP recommendations and favor their own personal preferences instead (Salm Ward, 2015). For example, Salm Ward (2015) found that parents maintained their belief that bed-sharing would protect their child from SUID even when they were aware this practice went against professional advice. Cultural preference, breastfeeding ease, increased supervision of the infant, and infant comfort are common reasons parents often cite for disregarding the AAP recommendations (Sobralske & Gruber, 2009).

Given concerns related to insufficient, inaccurate, and unclear information on the AAP guidelines, direct education on ways to minimize sleep-related risks is warranted. Such training should specifically focus on teaching parents to create a sleep environment that meets all the AAP's Guidelines. Training should highlight the reasons for each recommendation and additional tests should assess whether parents can recognize problems with infant sleep environments to determine potential skill generalization. To ensure compliance with the AAP guidelines, parents must know the guidelines, understand how to implement them, effectively carry-out the recommendations, and feel confident doing so (i.e., have high self-efficacy; Ryan

& Sawin, 2009). A safe sleep training program should encompass all of these components to promote skill acquisition and compliance.

Training Approach

Research has previously shown that simply providing instructions on how to change a behavior is insufficient, failing to result in skill acquisition or actual behavior change (e.g., Bonevski & Newell, 1999; Kornacki, Ringdahl, Sjostrom, & Nuernberger, 2013). Instructions are often presented in several formats, ranging from educational pamphlets to detailed instructional videos. Pamphlets with health information are easily misunderstood, forgotten, or ignored (e.g., Martin, Williams, Haskard, & DiMatteo, 2005). Even detailed training videos are commonly ineffective. For example, safety training videos have failed to protect children against the dangers of handling guns (Himle, Miltenberger, Gatheridge, & Flessner, 2004) or dangers related to strangers (Poche, Yoder, & Miltenberger, 1988).

Although data suggest that providing instructions alone is insufficient, behavioral skills training (BST) packages that include written instructions, modeling, rehearsal, and feedback have effectively taught new skills to various populations and resulted in associated behavior change (see Miltenberger, 2012 for a review). In BST, instructions describe the correct behavior in specific, easy-to-understand language. Modeling entails the instructor demonstrating the correct behavior for the learner. If an interaction is required in the desired skill, modeling may include role-play scenarios. Modeling may be live, where the observer and modeler are both present together, or symbolic, where the correct behavior is shown on videotape, audiotape, or in pictures. Symbolic modeling, such as video modeling, may be advantageous over live modeling because it has the capability to teach new skills to a larger audience (Poche et al., 1988). Following modeling, the learner rehearses the new skill and receives feedback. Rehearsal includes the learner practicing the new skill. Rehearsal allows the trainer to assess the individual's skills and provide feedback in the form of descriptive praise of appropriate behaviors and corrective feedback on any errors. Rehearsal serves the important role of allowing the trainer to verify skill acquisition. When individuals rehearse new skills and receive feedback they perform better than learners who only receive the instructions and modeling components (e.g., Poche et al., 1988).

BST has been used to teach a variety of skills, both simple and complex, to varying populations (e.g., Rosenthal & Steffek, 1991). For example, BST was used to teach social skills to diminish aggressive interactions among adolescents (Elder, Edelstein, & Narick, 1979), increase appropriate social behaviors among those with psychiatric disorders (Matson & Stephens, 1978), and train adolescent girls to refuse unwanted sexual advances (Warzak & Page, 1990). BST has also been effective in teaching interview (Hall, Sheldon-Wildgen, & Sherman, 1980) and conversation skills (Kornacki et al., 2013) to adults with mild or moderate disabilities. Complex skills have been taught to typically-developing adults through BST as well. Teachers, staff working with individuals with intellectual disabilities, and nursing home staff were taught to use behavior modification skills with the population they served (Engelman, Altus, Mosier, & Mathews, 2003; Lavie & Sturmey, 2002; Moore et al., 2002; Sarokof & Sturmey, 2004). Together, these studies show the broad applicability of BST across age group, skillset, and learner population, suggesting these methods could be used to teach parents to create safe infant sleep environments.

Modifications to BST to Enhance Effectiveness

BST should occur repeatedly until the learner reaches a specified criterion, often when the skills are demonstrated without error during training (Miltenberger, 2012). This ensures that participants can engage in all the desired behaviors correctly before training ends and increases the likelihood that participants can respond correctly in a variety of relevant, but variable, situations. Repeated practice until mastery increases the likelihood that individuals can and will perform the correct behavior in the natural environment once training is finished (Miltenberger, 2012). For example, Poche and colleagues (1981) instructed children to role-play an abduction prevention scenario until they completed all required steps correctly (i.e., say "no," run to a teacher, and report to the teacher what happened).

Administering portions of BST in a group can decrease the time and resources necessary for training (Miltenberger, 2012). This may be advantageous when a large population needs to learn a skill. Written instructions and modeling are often provided symbolically (e.g., Poche et al., 1981). With recent technological advances, computer programs may also replace the in-person rehearsal and feedback components as well, tailoring feedback to the individual's selections on a computer program. Using computer programs to deliver the complete BST package would increase training accessibility and reduce costs by allowing learners with access to computers to engage with the program whenever and wherever is most convenient for them. In the first known study of Computerized Behavioral Skills Training (CBST), a computer program effectively taught multiple safety skills to children (Vanselow & Hanley, 2014). In a series of studies using a single-subject design, Vanselow and Hanley used a computer game with BST to teach children to protect themselves from abduction. Skill acquisition, measured with a pre- and post-test of safety behavior in the natural environment, showed that CBST successfully taught children to protect themselves.

Assessing Generalization of Learned Skills

To increase the likelihood that learned skills translate into behavior change outside of training, it is suggested that training occur in a naturalistic environment. For example, in Vanselow and Hanley's (2014) CBST study, the researchers conducted in situ assessments in the natural environment and provided face-to-face feedback. This combined approach (CBST and in situ training) appeared to promote generalization to other safety skills. Specifically, the researchers reported that after teaching children to protect themselves from abduction, children were also able to respond safely when presented with two additional dangers, poison and lighters, without direct training.

Combining CBST with in situ training limits the widespread applicability of a computer program. CBST may still be effective when used in isolation so other measures assessing generalization without the need for on-site contact are needed. Assessing changes to infant home sleep environments would be costly, resource-intensive, and time-intensive. Individuals experience increased stress during the transition to parenthood (e.g., Miller & Sollie, 1980) and professional requests to enter parents' homes would likely add to this stress. Instead, generalization of sleep environment skills could be assessed symbolically with pictures. For instance, if participants are taught using computer-generated images, the generalization of these skills could be assessed by asking participants to identify sleep risks in various pictures of sleeping infants. Testing participants' identification of risks using pictures could be useful in assessing the generalizability of the computer program in a simple, convenient, and cost-effective way.

Infant Sleep Environment Changes

Even if parents are aware of the AAP Guidelines and can identify risks in sleep environment pictures, behavior change may not occur. Although knowledge and skill acquisition are main components in a training model, the primary goal is for parents to be able to implement the recommendations, not just understand them. The Health Belief Model (Becker, 1974; Rosenstock, 1974) provides a context for the likelihood of behavior change. This model states that together perceived threat, expectancies, and cues to action determine the likelihood of behavioral change. In the updated Health Belief Model (Baban & Craciun, 2007), the perceived susceptibility and severity of the behavior combine to form an overall "perceived threat" of engaging in the targeted behavior. For example, the extent to which people believe their child is susceptible to a sleep-related infant death (perceived susceptibility) and their understanding of how severe their infant's injury would be if they do not comply with the AAP guidelines (severity) is thought to determine whether they believe placing an infant to sleep in an environment that does not follow the AAP recommendations will result in death (perceived threat of not engaging in the targeted behavior). Expectancies in the Health Belief Model include self-efficacy and the perceived benefits and costs of engaging in the targeted behavior. Thus, safe sleep expectancies would include whether people believe they can successfully create a safe sleep environment (self-efficacy) and if this would preserve their child's life (benefits) or if it could result in poorer quality of their own, or the infant's, sleep (costs).

Together, the CBST package addresses each of these components. The instructions may serve as a cue to action to engage in the safe sleep behaviors outlined by the AAP. The rationale provided during the rehearsal and feedback components may increase the perceived susceptibility and threat by specifying unsafe behaviors and their potential consequences and increase the perceived benefits by highlighting ways to protect against infant death. Repeated practice engaging in the desired behavior, electronically, may increase participants' self-efficacy and belief they can create a safe sleep environment in their own home. Including each component of the Health Belief Model in the CBST package is designed to increase the likelihood of behavior change following training completion.

Assessing Likelihood of Behavior Change

Although difficult to assess actual change in safe infant sleep environment creation after completion of the training program, it may be beneficial to assess changes in reported perceptions of safe sleep behaviors and future sleep environment plans. The AAP Guideline against bed-sharing is a topic often debated among professionals as well as within the general public (e.g., Colvin, Collie-Akers, Schunn, & Moon, 2014; McKenna & McDade, 2005). A small fraction of professionals assert that bed-sharing is protective of SUID (e.g., McKenna & McDade, 2005) and some parents believe bed-sharing promotes healthy attachment and allows for closer monitoring (Salm Ward, 2015). Thus, if reported reductions in perceived bed-sharing safety or reported bed-sharing intent occur, it is likely that the training program may result in associated sleep environment changes for the other less-contested guidelines as well.

Health Literacy

Participant health literacy, or the ability to adequately understand health-related information (Chew et al., 2008), could impact the effectiveness of any training on health-related behaviors. Previous research has demonstrated a positive correlation between health literacy and medication compliance, adherence to prescribed dosage, and following doctor recommendations and instructions (Ross, 2013; Sorensen et al., 2012; Wong et al., 2014). Health literacy may be of even greater concern when training is completely conducted online, eliminating the potential for follow-up questions or further dialogue regarding health recommendations. Thus, it is possible participants may require higher health literacy to benefit from a training that only provides instructions, whereas participants with lower health literacy may benefit from a training that includes instructions, modeling, rehearsal, and feedback. Thus, assessing participant health literacy could assist in determining if some are more likely to benefit from different treatment packages than others.

The Current Study

The utility of a computerized BST package to teach parents how to create a safe sleep environment for infants was investigated. Written instructions are the current standard of care for educating parents on the AAP Guidelines (AAP, 2011; 2016). Therefore, written instructions (control) were compared to a CBST package in which the parents either completed the training once (BST) or repeatedly until they achieve 100% mastery on the post-test (BST-M). To assess generalization of learned skills with computer-generated images, parents completed additional pre- and post-tests in which they were asked to identify risks in three separate photographs of infant sleep environments. Parents were asked about perceived bed-sharing safety and engagement in bed-sharing behavior. Health Literacy was measured to determine potential differences in treatment effects. First, it was hypothesized that there would be significant improvement overall in participants' performance on each of the post-tests. Second, it was hypothesized that the CBST groups (BST and BST-M) would perform significantly better on the post-tests than the Instructions Only group and third, that the BST-M group would perform better on the post-tests than the BST group.

Methods

Participants

English-speaking community parents with at least one child between birth and 6 years old were recruited to participate in a larger study. Of 949 parents recruited, 246 had a child between the ages of 0 and 24 months old and met criteria to participate in this study. The youngest child between the ages of 0 and 24 months was identified as the focus child for all questions. The sample consisted of 188 mothers (76%) and 54 fathers (22%) between 19 and 52 years old (*M*=29.12, *SD*=5.39). Seventy-five percent of parents were married, 22% were single (never married), 2% were divorced and <1% were separated. Thirty-two percent of parents reported that they were college graduates (*M*=15.3 years of education, *SD*=2.18). Eighty-four percent of participants identified as Caucasian, 5% identified as Latinx/Hispanic, 5% identified as African American/Black, and 2% identified as Asian, 2% identified as mixed race, 1% identified as Middle Eastern, and <1% identified as Native American. The number of children in the participants' families ranged from 1 to 6 (*M*=1.79, *SD*=1.03). Fifty-one percent of the focus children were female and 48% were male. Forty-six percent were less than a year old and 54% were one year old. Fifty-two percent were the only child in the home, 47% were the youngest child, and 2% were the oldest, but not only child.

Procedure

The Institutional Review Board of a large Midwestern university approved this study. Participants were recruited by current undergraduate and graduate students taking an advanced psychology course to fulfill a course requirement or from fliers posted in a university daycare center. A snowball recruitment method was also used; participants were encouraged to recruit additional participants whom they thought might qualify for the study by showing or forwarding the flier, study information sheet, and consent form. There were no limitations on social media recruiting except that recruiters were instructed not to post the direct link to SurveyMonkey or the safe infant sleep website used for the training program. Rather, they were instructed to request that interested participants contact them for more details at which point they could provide the study information sheet and consent.

Students received course credit for recruiting at least eight community parents or, if unable to recruit parents, documenting their recruitment efforts. Providing the students credit for their recruitment effort, rather than participant initiation or completion of the study, was designed to dissuade coercion of parents to participate. All student recruiters completed a training on the ethical conduct of research. Participants provided informed consent before beginning the study. Upon entering the survey, participants indicated they had read the consent form, were age 18 or older, and were voluntarily agreeing to participate in this research study.

Once participants provided informed consent, they were asked questions regarding their health literacy and their own and the target child's demographics. As part of a larger study, participants then completed several additional brief questionnaires before they were redirected to a unique website domain created for this project. Participants were asked to create a unique four-digit ID which they typed into SurveyMonkey and were directed to write it down for later use. Specifically, parents were instructed:

> "Please think of a unique 4 digit numerical code (e.g., 1905). Please DO NOT use a common 4 digit code (like 1111 or 1234). Enter your code below and remember it (write it down!). We will not be able to remind you what it is. You will need it for the next part of the survey."

They were provided a hyperlink to the unique website and were asked to use their unique four-digit ID to enter the website domain, linking their SurveyMonkey data to their computer program training results while also maintaining their confidentiality. Both SurveyMonkey and the computer program database included timestamps so that if the same code was repeated among participants, the datasets might still be linked. In the case where the same code was used on the same day, demographic questions were further assessed to ensure the same person did not complete the study more than once. If the demographics were the same for age, gender, years of education, and marital status, the second dataset was removed. A total of nine cases were removed using these procedures. If the same code was used more than a day apart, suggesting different individuals used the same code, one of the codes was altered (e.g., 1998 changed to 19988) on both databases to allow for further analysis. A total of 17 codes were altered due to repetition of the unique codes more than a day apart.

Upon entering their unique ID into the computer program website, participants were randomly assigned to one of the three treatment groups: Instructions Only (Instructions), Behavioral Skills Training (BST), and Behavioral Skills Training to 100% Mastery (BST-M). A flow chart of the experimental design for the computer program is shown in Figure 1.

Approximately one third of the participants received instructions on creating a safe infant sleep environment (Instructions Only). Approximately one-third received the CBST treatment package one time (BST). Approximately one-third received the CBST package, but repeated the training until they created a safe sleep environment without any risks on the post-test, indicating 100% mastery (BST-M). Appendix A shows the complete computer training program content across instructions, modeling, rehearsal, and feedback components.

Each participant completed both pre- and post-training tests, serving as his or her own control. Participants were asked specific bed-sharing questions (see Materials section below) and then completed the pre-tests. First, on the sleep environment pre-test (baseline), all participants were asked to create a safe sleep environment using the program (pre-training), in which they chose various sleep environment components (e.g., the infant's clothing, sleep surface, bedding, and sleep position). The computer program tracked whether each response was correct or incorrect according to the AAP Guidelines. After completing their sleep environment, the program created a total percent mastery of the AAP's recommendations which was recorded on the program website, but not disclosed to the participant.

Second, all participants were provided with a picture probe generalization pre-test with three infant sleep pictures (see Appendix B). Participants were instructed to first list all the risks they saw in the environment for each of the three pictures. On the next screen, participants were asked to mark whether each of the 13 sleep environment risks was present in ("yes") or absent from ("no") the same pictures.

Third, participants began training based on their group assignment. All participants were provided numbered instructions on how to create a safe sleep environment (see Figure 2). Participants were unable to navigate forward to the next page of the program until 60 s elapsed to encourage participants to read the full instructions. This information was communicated to participants through a visual timer count down. Once the time elapsed, a button appeared stating "I have read all of these instructions." Participants had to affirm they read the instructions by clicking this button in order to move on. At this point, the Instructions Only group was done with training.

The other two groups continued through the CBST program and completed the modeling, rehearsal, and feedback components (see Appendix A). Participants saw three different computer-image examples of a safe sleep environment listing the correct computer program selections needed to create those environments. During sleep environment creation (rehearsal) every selection resulted in unique feedback including a brief rationale for the pertinent guideline. For example, after selecting the baby's clothing and regardless of the selection made, the feedback provided the AAP Guideline about ensuring the infant is not overheated and included the rationale: "Infants cannot change their body temperature easily and can overheat and experience heat stroke if too warm." Exact feedback for each response option is listed in Appendix A.

All groups then completed the computer program post-training test where they again created a sleep environment. For the BST-M group, if they did not score 100% on this post-test, they repeated the entire CBST package until they obtained 100% mastery on the computer program post-training test (again, refer to Figure 1). After all groups finished the computer program post-training test, they again completed the generalization post-tests of the same three infant sleep pictures. They were asked follow-up bed-sharing questions, thanked for their time, and then exited the training website.

Materials

Demographic Questions. Participants were asked their gender, age, marital status, ethnicity, years of education, number of children, and their youngest child's age, gender, and birth order.

BRIEF Health Literacy Screening Tool (BRIEF; Chew et al., 2008; Haun, Noland Dodd, Graham-Pole, Rienzo, & Donaldson, 2009; Wallace, Rogers, Roskos, Holiday, & Weiss, 2006). The BRIEF is a four item self-report measure on 5-point Likert scale, which yields a total level of Health Literacy (α= 0.77; Haun et al., 2009). Low scores, ranging from 4 to 12, suggest inadequate health literacy skills, meaning they have a difficult time interpreting health information. Moderate scores, ranging from 13-16 suggest marginal health literacy skills; meaning individuals might face some difficulty interpreting health information. High scores, ranging from 17-20, suggest adequate health literacy skills, meaning they do not typically have a difficult time interpreting health information.

Computer Program. A website-based computer program was developed for this study by a University electronics technician using the source code editor Notepad++, and programming languages: Hyper-Text Mark-Up Language (HTML), Cascading Style-Sheets (CSS), JavaScript, PHP, and Structured Query Language (SQL). Please contact the author for more information about the program. Participant responses were recorded on the website and exported into a Comma-Separated Values (CSV) file for analysis. Participants used their own computer and mouse to move through the content on each computer program page. The top of each page provided information on what phase of the experiment they were in (e.g., “Training”) and they progressed through the pages by selecting a “Next” button.

When building their infant’s sleep environment, participants were presented with a question, were given options for specific answers, and selected their answer by clicking on an associated image or radio button with their mouse (see Figure 3). When they made their selection, an image corresponding to that selection appeared in the “room” on the screen to the left of the question and response options, and then participants were instructed to place the object in the room by clicking on the desired placement location.

Participants provided both free-response and forced-choice responses to questions asking participants to identify risks in three sleep environment pictures (see Figure 4). First, when providing the free-responses, participants typed their responses in a text box and then selected “submit.” This hid their responses so that they could not navigate backwards through the program and see their responses after training. Second, participants were given the forced-choice to identify whether risks were present in each picture. To do so, participants were given a checklist based on the AAP Guidelines and used their mouse to select radio buttons for “Yes” or “No.” Depending on their screen size, they may have needed to use their mouse to scroll down the webpage; however, the picture scrolled as well so that it remained visible for every question (see Figure 5).

The computer program kept track of several outcome measures which were not available to the participants. Participants received a total score for the pre- and post-training computer environments as well as on both picture tests designed to assess the generalization of the skills to a more naturalistic environment. Total scores on creation of the sleep environment and checklist identification of risks were then converted to a total percent correct. Duration of participant computer program engagement was assessed by a timestamp indicating when a user logged into the website (entered the 4-digit ID) and when they answered the last question. The computer program also tracked the number of times the CBST package was repeated for those in the BST-M group.

Bed-sharing Questions. Before training on the computer program, parents were asked about their current bed-sharing behavior (i.e., "Have you engaged in bed-sharing with your infant?"). Responses included "Never," "Sometimes," and "Regularly." After training, they were asked if they would bed-share again (i.e., "Would you bed-share with your infant in the future?"). Responses were in a "Yes/No" format. Parents were also asked about their perception of bed-sharing safety (i.e., "Bed-sharing can be done safely") both before training and again after training. Responses were on a 1 to 4 Likert scale from 1, Strongly Disagree to 4, Strongly Agree.

Data Analyses

Frequency and descriptive statistics were used to characterize the participant sample and responses. Three separate mixed ANOVAs were used to determine mean differences between the three treatments from pre- to post-test (the within-subjects' pre-test and post-test scores) for each of the three outcome variables (creation of the sleep environment, free-response identification of risks in the sleep environment, and forced-choice checklist identification of risks in the sleep environment). To detect a moderate effect size in the difference between the three groups over time, at alpha value .05 and power=.85, a power analysis revealed that 48 participants would be required to have adequate power. Thus, with 105 participants completing both pre- and post-test on the sleep environment creation portions, this study had a sufficient sample to detect statistically significant differences. Bonferroni post-hoc tests were used with mixed ANOVAs (Field, 2013).

Accuracy of participants' free-response identification of sleep environment risks in the pictures was categorized using the Delphi model of coding (Jones & Hunter, 1995). First, a team of five research assistants coded the risks in the sleep pictures to create a key with the "correct" responses for each picture (i.e., which of the 13 risks were present). Second, when reviewing participant responses on the forced-choice questions, the research team read each response and identified common themes, beginning with the 13 AAP Guidelines. The themes were discussed among the research team, agreed upon, and assigned codes. In addition to the 13 guidelines, two additional categories were initially included: "Response Recorded" and "Other." Participants' free responses were recorded as "Response Recorded" when they double-clicked the "Submit" button, inadvertently erasing their original response and replacing it with "Response Recorded" message. "Other" responses included perceived risks that were not part of the AAP Guidelines. These "Other" responses were again discussed among the research team and assigned thematic codes. Responses were coded to majority agreement. Where appropriate, responses could be assigned multiple codes. Any items with less than 80% agreement were discussed among the team and recoded to consensus. Overall initial agreement was 92% or greater. Correct responses were given a score of 1 and incorrect responses were given a score of 0 and totaled to create an overall total score.

One-way ANOVA with Tukey's post-hoc tests (Field, 2013) were used to determine if Health Literacy predicted performance on the post-test and to determine the mean differences in duration between the three treatment groups. During preliminary testing of the program, training duration was never more than 60 minutes. Therefore, any duration longer than 3 times that (180 minutes) was dropped from the duration analyses as an outlier. Due to heterogeneity of the variance, a logarithmic transformation was conducted on the duration variable to establish homogeneity.

Mean change of perceived safety of bed-sharing from pre-to post-test was used to determine overall change in perception. A paired samples t-test was used to determine if this change from pre- to post-test was significant. A one-way ANOVA was used to determine if change in perceived safety of bed-sharing differed by treatment group. Change in reported bed-sharing behavior from pre- to post-test was assessed. Pre-test responses indicating prior bed-sharing (i.e., "Sometimes" and "Regularly") were combined and coded as "Yes/1" and responses indicating no prior bed-sharing (i.e., "Never") were coded as "No/0." A phi test was used to determine statistically significant change in intent to bed-share.

Results

Post-Consent Attrition and Lost Demographic Information

Figure 6 shows a flow diagram of participant enrollment, allocation, analysis, and exclusion. It also shows the number of participants with associated demographic information. Not all participants completed the entire study. Some post-consent participants were lost during the transition from SurveyMonkey to the training program. Other participants began the training program, but did not complete it. Additionally, some participants did not use a consistent, unique ID on both portions of the study. This resulted in a loss of associated demographic information for participants with training program data. This pattern of attrition created three separate demographic groups, those who were consented (presented in the Methods section), participants who began the training program, and participants who completed the training program. There were no significant differences between groups in reported gender, age, race, years of education, marital status, or levels of Health Literacy.

Participants who began the Training Program. Although 246 eligible participants completed the Surveymonkey portion of the study, only 156 (63%) logged into and answered the first question in the computer program (Figure 6). Of these participants, 37% were assigned to the Instructions Only group, 35% were assigned to the BST group, and 28% were assigned to the BST-M group. Pre-test results were analyzed for these participants.

Only 59 of the 156 (38%) participants had matching demographic information from SurveyMonkey. Of the participants with both SurveyMonkey and computer program data, 47 (80%) were female and 12 (20%) were male. Participants' age ranged from 19-53 years old (*M*=29.72, *SD*=5.88). Forty-seven (79%) identified as Caucasian, 3 (6%) as Latinx, 3 (6%) as Asian, 3 (6%) as African-American/Black, 2 (3%) as Mixed, and 1 (2%) as Middle Eastern. Forty-three (73%) were married, 14 (24%) were single, never married, and 2 (3%) were divorced. As a group, these participants were highly educated. Years of education ranged from 12-20 or more (*M*=15.97, *SD*=2.47). Number of children ranged from 1-5 (*M*=1.71, *SD*=.85). Twenty-nine (49%) were only children, 28 (48%) were the youngest child, and 2 (3%) were the oldest child, but not only.

Participants who completed the Training Program. Further, only a subset of the participants who began training by logging in completed the program. Out of 156 participants who began the training program, 121 completed the training (again, refer to Figure 6). In total, 75% of participants in the BST group (*n*=43), 83% in the BST-M group (*n*=35), and 72% of the Instructions Only group (*n*=43) completed training. For those who completed training, 36% were in the Instructions Only group, 36% were in the BST group, and 28% were in the BST-M group. Post-test results were analyzed for these participants.

Only 45 of these 121 (37%) participants had matching demographic information from SurveyMonkey. Of these participants, 36 (80%) were female and 9 (20%) were male. Participants' age ranged from 19-53 years old (*M*=29.86, *SD*=6.31). Thirty-six (80%) identified as Caucasian, 3 (7%) as Latinx, 2 (4%) as Asian, 2 (4%) as African-American/Black, and 1 (2%) as Mixed, and 1 (2%) as Middle Eastern. Seventy-three percent were married, 22% were single, never married, and 4% were divorced. These participants were highly educated. Years of education ranged from 12-20 or more (*M*=15.98, *SD*=2.47). Participants' number of children ranged from 1-3 (*M*=1.67, *SD*=.77). Twenty-three (51%) were only children, 21 (47%) were the youngest child, and 1 (2%) was the oldest, but not only child.

Training Feasibility

Training Duration. Duration of training program completion was assessed. One outlier (352 minutes, from the Instructions Only group) was dropped. Overall, the duration of training regardless of treatment group was relatively brief (*M*=24.22 minutes, *SD*=17.91, range 7-116). As expected, participants in the Instructions Only treatment group completed the training in the shortest time in minutes (*M*=21.23, *SD*=16.95, range 7-114), followed by BST (*M*=22.05, *SD*=8.35, range 12-55), and BST-M (*M*=30.57, *SD*=25.16, range 12-116). A one-way ANOVA revealed a significant difference in duration to complete the training program by treatment group, $F(2,118)=5.34$, $p=.006$. Tukey's adjusted post hoc analyses indicated no significant difference between BST and BST-M (ns) and BST and Instructions Only (ns); however, there was a significant difference between BST-M and Instructions ($p<.01$), indicating that the Instructions Only group spent significantly less time completing the training than the BST-M group.

BST Repetition. Only two participants (6%) had to repeat the training program a second time. This lack of repetition resulted in nearly identical CBST treatment groups, limiting the potential BST and BST-M group comparisons that could be made in the present sample. For instance, it is not surprising that there was no significant difference in the duration of the BST and BST-M groups as most of these participants experienced identical training requiring only one iteration to reach 100% on the post-test.

Program Problems. Some responses were lost due to computer programming error. If participants double clicked the "submit" button after entering the risks they identified in the three pictures, their responses were lost and replaced with "Response Recorded." Overall, 43 of responses were lost (4%) due to this programming error. On picture 1, 17 responses were lost (13%) on the pre-test and 4 (3%) were lost on the post-test. On picture 2, 1 response was lost (<1%) on the pre-test and 1 response was lost (<1%) on the post-test. On picture 3, 7 responses (6%) were lost on the pre-test and 3 were lost (2%) on the post-test.

Many participants were lost (n=90) during the transition from SurveyMonkey (n=246) to the computer program (n=156). Further, of those participants who successfully entered the computer program, only a small portion (n=45) had matching SurveyMonkey records despite instructions about creating a self-identified 4-digit code to link the two databases.

The program also tracked the number of repetitions required before mastery for those in the BST-M group. One of the participants who had to repeat training was given an imperfect score on the post-test in the tracking sheet. This indicates a clear programming error as they were able to proceed through the study despite the imperfect score that was recorded on the program website. Possible reasons for this problem are discussed in the Discussion under the Limitations and Future Directions section.

Safe Sleep Environment Results

A mixed ANOVA showed a significant main effect of training with improvement in percent mastery of safe sleep environment creation from the pre- (M=78.80, SD=16.20) to the post-test (M=96.45, SD=7.83), $F(2,102)=123.62$, $p<.001$ (Figure 7). The mixed ANOVA results revealed a significant main effect of treatment group in the creation of a safe sleep environment, $F(2,102)=6.63$, $p<.01$. Bonferroni corrected post hoc tests showed that the percent mastery score in the safe sleep environments did not significantly differ for the BST (M=90.15, SD=1.45) and BST-M (M=89.84, SD=1.73) groups (ns), but the Instructions Only (M=83.04, SD=1.56) group performed significantly worse than the BST group ($p<.01$) and BST-M group ($p<.05$). There was no significant interaction between the treatment group and overall training from pre- to post-test, $F(2,102)=.337$, ns, suggesting that the improvements with training did not differ significantly by treatment group.

Generalization Tests

Participants were asked to identify risks in three sleep environment pictures, first by providing free responses and then in a forced-choice format by using a checklist based on the AAP Guidelines. Results are presented separately.

Free-Response Identification of Risks in Pictures. A mixed ANOVA revealed a significant main effect of training with an increased number of correct free-response risks identified from pre- (M=6.26, SD=2.33) to post-test (M=7.97, SD=2.43), $F(1,123)=56.10$, $p<.001$ for all three pictures (Figure 8). However, there was no significant main effect for treatment group on the number of free-response risks identified, $F(2,123)=.041$, ns, suggesting that BST

(*M*=7.16, *SD*=.30), BST-M (*M*=7.13, *SD*=.35), and Instructions (*M*=7.05, *SD*=.31) did not perform significantly different when asked to identify the number of risks from the three pictures. Further, there was no interaction between total free-response identification of risks and treatment group, $F(2,123)=.206$, ns.

The first picture had nine risks identified by the research team. On the pre-test, participants reported fewer correct risks (*M*=2.27, *SD*=1.44, range 0-6) than on the post-test (*M*=3.21, *SD*=1.47, range 0-6). Of note, no participant correctly identified all nine risks even after training was completed. However, from pre- to post-training for picture 1, 64 (56%) participants correctly identified more risks, 35 (28%) identified the same number of correct risks, and 21 (17%) reported fewer correct risks (Figure 9).

The second picture had four risks identified by the research team. On the pre-test, participants reported fewer correct risks (*M*=2.07, *SD*=.92, range 0-4) than on the post-test (*M*=2.57, *SD*=.84, range 0-4). From pre- to post-training for picture 2, 56 (45%) participants correctly identified more risks, 54 (43%) identified the same number of correct risks, and 16 (13%) identified fewer correct risks (Figure 10).

The third picture had four risks identified by the research team. On the pre-test, participants reported fewer correct risks (*M*=1.92, *SD*=.84, range 0-4) than on the post-test (*M*=2.21, *SD*=.76, range 0-4). From pre- to post-training for picture 3, 48 (38%) participants correctly identified more risks, 59 (47%) identified the same number of correct risks, and 19 (15%) identified fewer correct risks (Figure 11).

Pattern of Free-Response Risks Identified/Overlooked. In the free-responses that participants gave to identify risks in the sleep environment, there were some risks that were identified and missed more than others. Responses were scored as correct if they either correctly identified a risk that was present (hit) or correctly omitted identifying a risk that was not present (correct rejection). Thus, for each risk, across the three pictures and two time points, a total score of six would indicate they correctly identified risks and omitted identifying risks that were not present. Across all risks, scores ranged from 0 to 6 (M=4.58, SD=.85) with some risks more likely to be overlooked than others (Figure 12). Specifically, parents were least likely to identify/omit possible suffocation due to something covering or possibly covering the infant's head. Parents were also less likely to identify the risk of something soft or loose present in the sleep area and the risk of overheating. On the other hand, parents were most likely to correctly identify/omit that toys or a baby monitor were on the sleep surface, the mattress was loose (not present in any images), the sheets were loose (not present in any images), that the infant was not sleeping supine, and that the infant was bed-sharing. These results suggest the possibility that some of the guidelines may have been easier to understand or identify.

"Other" Free-Response Answers. Upon inspection of the free-response answers listing risks in each picture, some parents included comments that did not fit any of the AAP Guidelines. In total, there were 61 "Other" responses in the free-response section of the picture tests. Of these 61 "Other," 38 (62%) were on the pre-tests and 23 (38%) were on the post-tests. Picture 1 had 3 (5%), Picture 2 had 37 (61%), and Picture 3 had 21 (34%). There were three overall themes identified from the responses: other risk, no risk, and statement of disagreement with the guidelines. A large number of the risks falling within the "statement of disagreement with the guidelines" category dealt specifically with the presence of a pacifier. That is, parents disagreed that a pacifier was protective of SUID and instead identified a pacifier as a hazard. Thus, this risk was separated out as its own category for further analysis (Figure 13). Participants listed 52 (44%) other risks, 6 (10%) responses indicated the participant believed no risks were present/or declined to respond, and 28 (46%) disagreed with the AAP Guidelines. Of these 28 responses that disagreed with the AAP Guidelines, 25 (41% of the total responses) indicated a pacifier was a risk.

"Other" responses indicating risks that were not included in the AAP Guidelines included responses such as, "loose fitting clothing" and "baby doesn't look strong enough to be on tummy, face is down and not to the side." Some parents declined to respond or did not report any risks. For example, one parent said, "I've already done this" whereas another said, "None." Finally, some parents believed the guidelines were dangerous or simply disagreed with them. For example, one parent said, "…overall as long as mother is sober and comfortable, I believe mother's gut is always right." Another parent said, "If the baby spits up it will choke" regarding Picture 3, which shows the infant on his back. Responses suggesting a pacifier was a risk (without mentioning a cord being attached) included responses such as, "The pacifier is a problem that can cause choking."

Checklist Identification of Risks. A mixed ANOVA found no significant main effect of training in the percent correct identification of risks in the pictures from pre- (M=80.60, SD=10.17) to post-test (M=80.53, SD=9.72), $F(2, 117)$=.015, ns, using the checklist (Figure 14). The mixed-ANOVA results also did not reveal a significant main effect of treatment group, $F(2, 117)$=1.059, ns, with Instructions Only (M=81.52, SD=1.20), BST (M=79.19, SD=1.20), and BST-M (M=81.11, SD=1.13), performing similarly. There was no significant interaction between the treatment group and training, $F(2, 117)$=.324, ns.

Health Literacy

Overall (n=244), the present population had adequate Health Literacy scores (M =18.53, SD = 2.12) suggesting they do not typically have a difficult time interpreting health information.

Total scores ranged from 8-20 with 210 (86%) participants falling in the high Health Literacy range, 26 (11%) in the moderate Health Literacy range, and 7 (3%) in the low Health Literacy range. Of the smaller sample that had both Health Literacy Scores and Computer Program results (n=40), 5 (13%) had moderate Health Literacy scores (M=15.2, SD=.80) while the remaining 35 (87%) had high Health Literacy scores (M=19.0, SD=.86). A one-way ANOVA was used to determine if Health Literacy predicted performance on the sleep environment post-test. Health Literacy was not a significant predictor of performance on the sleep environment post-test, $F(5,39)$=.682, ns; those with moderate Health Literacy scores (M=100.00, SD=0) did not perform significantly different than those with high Health Literacy scores (M=94.81, SD=9.21).

Bed-sharing Questions

Prior to and again after training, participants were asked questions about their perceptions of bed-sharing safety and bed-sharing behavior to assess whether the training changed safe-sleep beliefs or future sleep environment intentions (Figure 15). Of 150 participants, about two-thirds of parents agreed or strongly agreed that bed-sharing could be done safely (M=2.80, SD=.91); however, on the post-test, the perceived safety of bed-sharing shifted towards disagreement (M=2.06, SD=1.05), with about two-thirds of parents reporting they strongly disagreed or disagreed. Out of 120 participants, 55 (15%) did not report a change in the perceived safety of bed-sharing, 63 (53%) reported a reduction in the perceived safety of bed-sharing, and 2 (<1%) reported an increase in the perceived safety of bed-sharing. A paired samples t-test showed that this was a significant reduction in the perception of bed-sharing safety from the pre-test (M=2.74, SD=.92) to post-test (M=2.06, SD=1.05), t=9.37, p<.001. A one-way ANOVA revealed change in perceived bed-sharing safety did not differ by treatment group, $F(2, 117)$=1.98, ns, with

Instructions Only (*M*=-.58, *SD*=.80), BST (*M*=-.60, *SD*=.82), and BST-M (*M*=-.91, *SD*=.82) showing similar reductions in perceived bed-sharing safety.

Second, participants were asked about their previous bed-sharing behaviors and plan to bed-share in the future (Figure 16). Of 150 participants, 35% (*n*=53) reported never bed-sharing, 35% (*n*=53) reported sometimes bed-sharing, and 29% (*n*=44) reported regularly bed-sharing. These results suggest bed-sharing occurred in the majority of this sample. After completing the training program, there were many participants who previously bed-shared who reported on the post-test that they no longer planned on bed-sharing. Of the 120 participants who completed both the pre-test questions and post-test questions, 67% (*n*=80) did not report any change in bed-sharing likelihood; however, 33% (*n*=40) reported a switch from current/previous bed-sharing behavior to planned future bed-sharing avoidance. A phi test revealed this change in previous and future planned bed-sharing behavior was significant, ϕ=.496, *p*=<.001. There was no difference in reported change from pre- to post-training by treatment group, ϕ=.112, ns.

Discussion

Avoiding known sleep environment risks is essential to reduce SUID (AAP, 2011; 2016). This study assessed the utility of a computerized training program to teach parents how to create a safe sleep environment consistent with the AAP Guidelines (2011). All groups received some form of training (Appendix A): Instructions Only, the current standard of care; BST, in which participants received instructions, modeling, rehearsal, and feedback one time; and BST-M, in which participants received the four training components repeatedly until mastery was achieved on the post-test. This study also assessed generalization of skills acquired during training to a more natural representation of a sleep environment. To do so, parents were asked to identify risks in three separate infant sleep pictures first without any assistance and again with the assistance of a checklist based on the AAP Guidelines (2011, Appendix B).

Hypotheses

It was hypothesized that, overall, participants' performance would improve from pre- to post-test on creation of a safe sleep environment and the two risk identification generalization tests. The first hypothesis was partially supported. Overall, participants' post-test performance was significantly better on safe sleep environment creation and free-response identification of risks, but not on the checklist identification of risks. Second, it was hypothesized that the two computerized behavioral skills training groups (BST and BST-M) would perform significantly better than the Instructions Only group on all three post-tests. The second hypothesis was not supported. When comparing the three treatment groups on creation of a safe electronic sleep environment, participants in both the BST and BST-M groups performed significantly better than Instructions Only group overall, but this difference was not specific to the post-test scores. There were also no significant differences in performance on either of the generalization picture tests by treatment group. Third, it was hypothesized that the BST-M group would perform significantly better than the BST group on the post-tests. The third hypothesis was not supported. There was no difference between these two groups on any of the post-tests.

Overall Results. The overall participant population was highly educated and had high health literacy suggesting little difficulty understanding health-related information. All results should be interpreted with the understanding that the sample may not be representative of a more diverse population of parents.

Regardless of treatment group, participants demonstrated significant improvement in their mastery of the AAP safe sleep guidelines when asked to create a computerized representation of a sleep environment after training. Further, parents were not only able to create a safer electronic sleep environment after training, but also identified significantly more risks in three separate infant sleep images. However, more risks were identified with the help of the checklist based on known sleep risks. In fact, risk identification using the checklist did not differ from pre- to post-test. These results demonstrate the efficacy of a computerized training on creating safe sleep environments consistent with the AAP Safe Sleep Guidelines (2011) and identification of risks without a checklist. These results suggest the utility of a safe infant sleep "babyproofing" checklist (Appendix C) to aid in the identification of infant sleep risks.

Sleep Environment Creation. The overall results showed there was a significant difference from pre- to the post-test on sleep environment creation, suggesting that all groups benefitted from training. In the present sample, even participants in the Instructions Only group made significant gains. These results differed from previous research. Education through informational handouts or other instructions are often minimally effective in changing health behaviors and are easily discarded, misunderstood, or forgotten (Martin et al., 2005). Previous studies have shown that instructions can increase knowledge, but may not result in behavior change (see Bonevski & Newell, 1999 for a review). It is possible that in combination with a highly health literate sample, some of the additional programming components increased the effectiveness of instructions. A 60-s timer delayed participants from moving from the instructions page to the next section of the study. Participants also had to select a button stating they read the instructions before the "Next" button appeared (Figure 2). Additionally, participants were required to practice or rehearse creating a sleep environment and identify risks based on these instructions directly after seeing them. Bonevski and Newell (1999) state instructions can be helpful when included as a component in additional interventions. It is possible the timer promoted parents to read the instructions, rather than dismiss them, and in effect, resulted in greater knowledge acquisition. It is also possible that these results were simply due to the high health literacy in the present sample. Further, it is possible that the direct application of the instructions on the post-tests contributed to the effectiveness of the interventions. However, it remains unclear if the rehearsal and identification of risks through the post-test uniquely contributed to the overall improvements for the Instructions group. This should be further explored in future research as it is possible the simplest, most cost-effective interventions in a sample with high health literacy could be to use electronic instructions with a timer or have providers read the instructions to the parent, ensuring the instructions are heard.

In addition to overall improvements in sleep environment creation, there was differential performance by treatment group. Overall, both BST groups performed significantly better than the Instructions Only group. However, there was no significant interaction, suggesting that performance on the pre-test contributed to this significant difference. Previous literature suggests BST is an effective tool to promote skill acquisition, even with complex behaviors (e.g., Nuernberger et al., 2013) and provides added benefits beyond instructions alone (e.g., Kornacki et al., 2013). The results of the present study partially add to this body of work by expanding the known effectiveness of a computer program to deliver BST (Vanselow & Hanley, 2014) and demonstrating the utility of BST to teach another complex skill. However, in the present highly educated and health literate sample, the additional BST components did not provide significant unique contributions to overall performance on the post-test beyond Instructions alone.

Further, it was somewhat surprising that there were no differences in BST and BST-M groups given previous recommendations to conduct training until mastery to ensure adequate skill acquisition (Miltenberger, 2012). However, in the present sample, only two participants required repetition of the BST training package. This resulted in nearly identical treatment conditions, despite the different group assignment and study design. This suggests a ceiling effect in which most participants were able to score 100% on the post-test after one training session. It is also possible that in a more high-risk sample, the initial training session (i.e., BST one time) would not be as effective and repeated presentation of the training (BST-M) would be beneficial. Repeated training in the BST-M group would also further differentiate the two CBST conditions with marked differences from the first to final BST session. The Instructions Only training still resulted in significant improvements on the post-test. If participants could quickly navigate past the instructions, discarding the information (Martin et al., 2005), instructions alone may not have been as effective and, again, the group differences may have been even more pronounced. One of the advantages of using the complete treatment package is that the instructions are repeated indirectly during modeling and directly during feedback. Thus, even if participants ignored the written instructions in the first component of the BST package, participants are still exposed to the instructions in the other treatment components.

Those with lower health literacy have difficulty understanding health related information and adopting new skills and behaviors even after instructions are provided (Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011). It is possible that those with higher health literacy may acquire skills quickly, with little need for repetition or clarification. Differences in group performance may be more pronounced in a more diverse population in which skill acquisition may be more variable depending on overall health literacy. Specifically, the repetition of instructions, opportunity to see examples, and repeated practice with feedback in the BST components may be more beneficial to populations with lower health literacy. Further, in learners requiring more practice, the number of BST repetitions would likely increase, creating more pronounced group differences. Greater disparity between these treatment groups would allow for further analysis of differential treatment effects and perhaps reveal participant characteristics that make one of the trainings more, or less effective. The BRIEF or other short assessments could then be used to identify those participants who may require the more intensive BST treatments.

Generalization: Free-Response Risks. We hoped if parents could create a safe electronic sleep environment, these skills might translate to creation of a safe sleep environment in their home. However, such assessment would require someone to travel to, and inspect, participants' homes or for parents to travel to an office and create a sleep environment in a staged room. In-person generalization assessments are time and resource-intensive, both for the learner and trainer, and limit the applicability and utility of a computerized training program (Vanselow & Hanley, 2014). Instead, additional tests were designed to investigate the likelihood of skill generalization. The generalization tests asked parents to identify any potential risks in pictures of three sleep environments, rather than using computer-generated images. This modality served two functions. First, using pictures rather than electronic images provided a closer approximation to a natural sleep environment. Miltenberger (2012) suggests using an environment that closely approximates the environment in which the skill will be needed. Second, it assessed the likelihood that parents would be able to identify risks in sleep environments. This is a skill not specifically taught during training, but would be important to ensure utilization of safe infant sleep environments daily. For example, other children or caregivers may inadvertently alter the environment, creating new or additional risks (e.g., if an infant is given a toy to play with while awake and monitored in a pack and play). Parents would need to inspect the safety of their infant's sleep environment prior to each sleep onset.

Participants made significant improvements in their identification of risks across the three pictures from pre- to post-test. Again, these results reiterate the effectiveness of a computerized safe sleep training, despite treatment group. Even though participants could identify significantly more risks on the post-test, participants identified less than half of the total risks present. These results are concerning. Although any reduction in risk is significant, further intervention may be warranted to ensure all risks are readily identifiable after training. Nevertheless, there was a moderate improvement in number of free-response risks that participants identified. Further, improvement in the free-response identification of risks did not differ by treatment group. The overall low performance on this measure may have limited group variability.

Given the number of risks that were not correctly identified, further analysis was conducted to determine parent response patterns. Some of the AAP Guidelines were reported less often. Parents were least likely to identify the possibility of infant suffocating, the presence of soft or loose bedding in the sleep area, and the risk of overheating. Although separate recommendations, they are often related. For instance, the presence of a blanket should have resulted in the identification of all three risks. An infant could suffocate from the blanket covering his or her airway, a blanket is a soft and loose item, and could contribute to overheating. Some parents may have known these were combined risks, but may not have fully specified them in their response. For instance, many parents simply stated, "blanket." In these cases, the response was only coded as the presence of a soft or loose item in the sleep area. These parents may have known that a blanket could cause suffocation or overheating, but their succinct response did not convey this knowledge. A smaller pilot study could investigate participants' awareness of these combined risks by asking parents clarifying questions (e.g., "what do you mean when you say a blanket is a risk?") to test the limits of their knowledge.

On the other hand, it is possible that parents were simply not aware of these additional associated risks. Of note, all three pictures included a blanket and in two of the pictures the blanket was on top of the infant. Parents might benefit from clearer, or repeated, instructions on these combined risks as well as a more detailed rationale. These combined risks, each associated with a blanket, could be presented together on the feedback portion of training to aid recall (Neath & Surprenant, 2003; Tulving & Craik, 2000).

Some participants also provided responses that did not fall within the AAP Guidelines. Most of these additional responses identified perceived risks that are not specifically included in the AAP Guidelines. Together with the results that many parents could only identify a few correct risks, this suggests poor knowledge of the AAP Safe Sleep Guidelines prior to training. Further, Austin and colleagues (n.d.) found that parents often misunderstand the AAP Guidelines, despite awareness of the specific guidelines. However, the overall number of "Other" responses decreased substantially from pre- to post-test while the number of correct free-responses increased, suggesting that the training may both increase knowledge of the guidelines, but also enhance applicability of this knowledge when designing a sleep environment. These results may also serve as another indicator of knowledge acquisition.

Many participants reported pacifiers were a safety risk, but, per the AAP (2011; 2016), pacifiers without cords are protective of SUID. These responses decreased after training. A small number of participants also openly disagreed with the AAP Guidelines when asked about safety risks. Austin and colleagues (n.d.) found that agreement with the recommendations predicts caregiver compliance with the guidelines. Again, the number of these responses decreased after training was completed. This hopefully suggests that parents may better understand the rationale behind the AAP Guidelines with which they previously disagreed with prior to training, and that after training this belief changed. Future research would need to directly investigate this possibility. These response patterns provide an indication of knowledge acquisition and, potentially, even a change in perceptions. Further training impact on parent perceptions is discussed in the Bed-Sharing Questions section below. Some parents were unable, or declined, to identify any risks. These responses increased after training suggesting parents may have become fatigued with training.

Generalization: Checklist. Although participants were unable to list all the risks pictured without assistance in the free-response questions, they identified most risks (~80%) when using the checklist based on the AAP Guidelines as a reference. This was true not only on the post-test, but on the pre-test as well. In fact, there was no improvement in the identification of risks from pre- to post-test and performance did not differ by group. These results suggest that even prior to training, the checklist may help parents identify and mitigate sleep environment risks. The checklist did not differ much from the instructions portion of training; the checklist indicated potential sleep environment risks whereas the instructions advised ways to avoid risks. Checklists have been useful in mitigating risk in other areas of injury-prevention (e.g., Gawande, 2009). For example, "baby proofing" describes the process of listing known risks (e.g., power outlets), explaining how to mitigate the risk (e.g., use outlet covers), and provides a means for checking items off once the risk is removed. Future research would need to assess the utility of, and associated behavior changes with, a safe sleep checklist as an intervention. Again, this could be an alternative and simple intervention for those with high health literacy.

Bed-Sharing Questions

From pre- to post-test the perception of bed-sharing safety significantly diminished, such that parents perceived bed-sharing as less safe on the post-test. A significant number of parents who previously bed-shared reported they would not bed-share in the future. The major aim of the present project was to assess the utility of a computer program to teach parents how to create a safe sleep environment. However, it was hoped that the study design would promote parents to use the knowledge they gained to change their behaviors and, ultimately, reduce risks in their infant's sleep environment.

Parents were asked about bed-sharing as a potential indicator as to whether the training may result in overall changes in perceptions and behaviors. The AAP Guideline on bed-sharing is arguably the most controversial (e.g., McKenna & McDade, 2005); parents admit disregarding clear advice against bed-sharing (e.g., Ateah & Hamelin, 2008; Chianese, Ploof, Trovato, & Chang, 2009) and may openly disagree with professionals (Austin et al., n.d.). Some parents believe bed-sharing promotes healthy attachment and allows for closer monitoring of their child (Salm Ward, 2015). Some professionals even assert that bed-sharing does not increase the risk for SUID, but that associated sleep factors (e.g., soft/loose bedding in the sleep area which could suffocate or overheat the infant, the greater likelihood of entrapment, or adult substance-use) place infants at a greater risk (e.g., McKenna & McDade, 2005). It is unlikely that someone could eliminate all the risks associated with bed-sharing (AAP, 2011; 2016). Further, in cases where infant death is attributed to accidental suffocation or strangulation in bed, over 50% were bed-sharing at the time (Blair, Sidebotham, Evason-Coombe, Edmonds, Heckstall-Smith, & Flaming, 2009). Due to factors such as these, the AAP strongly opposes bed-sharing with infants (AAP, 2011; 2016). Thus, the significant change in perceived bed-sharing safety and future bed-sharing intent is notable. Although some of this shift could be due to experimenter demand effects given the clear guidelines against bed-sharing throughout the training, these results strongly suggest reduced bed-sharing behavior in the future. Given the change in parents' perceptions about bed-sharing safety and bed-sharing intent, it is possible similar perceptions about other, less controversial guidelines, and the associated behaviors might change as well.

Although this bed-sharing change in perception and intent significantly changed after training, there was no significant difference by treatment group. These results reinforce the idea that in a highly health literate population, instructions may be a sufficient intervention to increase knowledge and the perceptions of, and compliance with the AAP Guidelines. In a retrospective study, Austin and colleagues (n.d.) found that in a similarly health literate sample, parent awareness of the AAP Safe Sleep Guidelines predicted compliance. The results of the present study add to this literature and provide hope that training could result in significant risk reduction.

Training Feasibility & Utility

Duration. In a short training period (i.e., 24 minutes), participants made significant gains in safe sleep knowledge. The total duration included the time to complete the pre-tests and the generalization tests. Outside of this study, parents would only need to complete the training portion and, if in the BST-M group, the sleep environment creation post-test. This would further shorten training duration and make the training program even more feasible. In the present population, few participants required training repetition. This brief training is short enough that parents could complete the entire program on a computer while in the waiting room for a doctor's appointment, as one component in a child birth education class, or at a local health department before an appointment.

Difficulties. Attrition posed a significant problem with the present study and dropout cause is unclear. In terms of completing the entire study, participants could have grown fatigued. Participants first reviewed an information sheet and consent, then completed demographic and brief screeners on SurveyMonkey prior to transitioning to the safe sleep website. Thus, training duration did not account for total time spent on the study.

Participants may have also had difficulty following multi-step directions. On SurveyMonkey, participants were asked to think of a four-digit ID and to write it down, and then click the link (or copy and paste a link into another browser) to continue the study. After transitioning to the other website, they were asked to re-enter their four-digit ID. Anecdotally, some recruiters provided feedback that participants asked questions about this process indicating some difficulty understanding the instructions. For example, some participants reported that when they clicked the link, nothing happened (likely due to a pop-up blocker). Many participants who completed the computer program did not have linking SurveyMonkey data. This further suggests difficulty with the transition process. It is possible participants entered a slightly different four-digit ID through typing error, forgot their ID, or did not follow instructions. The required transition from one website to another may have introduced bias into the sample; requiring greater electronic media skills from participants in order to successfully complete the transition; however, both the overall participant population and those that completed the training had adequate Health Literacy skills and the sample demographics did not significantly differ.

Limitations & Future Directions

Programming. Despite programming to equally assign participants to one of the three treatment groups, group assignment was not equal. More participants were assigned to the Instructions Only and BST treatment groups than the BST-M treatment group. Continued program testing occurred after launching recruitment. This may have interfered with equal group assignment. Although the database was cleaned of all pilot-testing data, any pilot test group assignment would have counted towards the program’s randomized assignment. Future research should conduct all piloting separate from the study to prevent disruption of the program's randomization procedure and prevent unequal group distribution.

Some free-response answers were lost due to programming error as well. This may be due to lower computer literacy, with participants failing to follow directions accurately, or from accidental double-clicking. However, the lost data was identifiable, as the participant responses were replaced with the set phrase, "Response Recorded." This error disproportionately affected responses on the pre-test and the first picture. The number of risks identified were also lower on the pre-test and on the first picture. It is unclear if there was a systematic reason for this trend; however, it is likely that participants were learning how to navigate the program because errors reduced as training progressed. It is unclear how this error may have impacted the results. Future work should fix this error by preventing the overwrite operation so that the first response submitted is saved for analysis.

One participant in the BST-M group was able to proceed through the program despite not scoring 100% on the post-test sleep environment creation. This resulted in an overall score of less than 100% for the BST-M group, which should have been impossible. Closer inspection confirmed this participant did not drop out prior to finishing the test, so a score of 100% should have been obtained before he or she could continue through the program. This score indicates some form of unknown error with the computer programming. It is possible their first post-test score was recorded; however, the other participant who had to repeat the training received a score of 100%, suggesting this hypothesis was not the case (as they would have not needed to repeat the training). It is also possible the program did not require him or her to repeat the training after scoring less than 100% for the second time and instead the participant was able to proceed through the program. For the BST-M treatment group to be implemented outside of the present study, this error would need to be confirmed and fixed.

Content. Attempts were made to use pictures that incorporated all 13 sleep risks identified in the AAP Guidelines. However, none of the pictures included a loose mattress or loose sheets. Notably, this may suggest that mattresses that are too loose for a crib or mattresses that have loose sheets may not be as common of a problem as the other risks given this difficulty in finding a sleep environment picture with these components. This prevented analysis of training program effectiveness on identification of these two risks. Future research should include pictures representative of all 13 risks. Some risks were also missed more often than others (i.e., suffocation due to head covering, soft/loose bedding in the sleep area, potential to overheat the infant). Often occurring together, these combined risks should have greater emphasis during training.

Generalization Tests. Despite a significant improvement from pre- to post-test, the poor performance on free-response identification of risks and disproportionately better performance on the checklist identification of risks may bring into question the appropriateness of the picture tests to assess generalization. Figure 17 shows how the appropriateness of the present generalization tests may be more completely assessed in future research. In Figure 17, (A) represents the major outcome variable in this study: parents' creation of a computerized safe sleep environment. The most appropriate generalization test would be to inspect parents' creation of a sleep environment in their home after training (B). However, to keep the entire training and assessment online, another generalization test could investigate whether a computer program could allow parents to place pictures of real sleep objects (e.g., an actual crib rather than a computer-generated crib) in the picture of a real room (B), more closely replicating a real sleep environment. Funding constraints prevented the creation of a three-dimensional, and fully interactive, sleep environment test of this sort.

Another possibility would be to ask parents to identify risks in a computer-generated sleep environment (C) and assess generalization using the procedures in this study (D). If the results from (A) and (B) are positively correlated, we might conclude that (B) was an appropriate test of generalization for (A). If the results from (C) and (D) are positively correlated, we might conclude that (D) was an appropriate test of generalization for (C). However, in order to determine if (D) was an appropriate test of generalization for (A), we would likely need to see if there was a positive correlation between (A) and (C) first, where the same modality was used, but slightly different skills were assessed. It is possible the picture tests represent an entirely different skill (e.g., identification of risks) rather than generalization of the primary target skill (e.g., creating a sleep environment with safe components). Future research should investigate these options further. Perhaps the appropriateness of the generalization tests could be explored with a more intensive intervention on a smaller group of participants. A home visitor or tele-consultant could inspect the sleep space or participants could be brought in to a lab and conduct an in vivo sleep environment test.

External Validity of Training Results. The parent demographics in the present sample were quite homogenous. Most participants were highly educated, married, white women with adequate health literacy. To fully determine the effectiveness and utility of the present training program across a larger population, and the effects of Health Literacy on skill acquisition, future research on a more diverse sample is needed. Anecdotally, attempts were made to recruit a more diverse population. One recruiter asked for, and received, permission to post the flier in a community health clinic within a predominately low-income minority neighborhood in a larger metropolitan city. The small number of minorities in the present sample suggests this posting did not result in the acquisition of many minority participants. Further incentive or face-to-face contact may be required. Future research could explore use of a raffle or small gift card as incentive for participation. Additionally, recruitment partnership with a community mental health organization or hospitals could prove beneficial. The investigator reached out to the local health department which was unable to partner on this project at the time.

In addition, future research should target a variety of caregivers rather than just parents. Babies may be cared for by other family members such as grandparents or aunts/uncles, nannies, baby-sitters, or daycare staff, as well as family friends. Thus, it will be important to determine if the results of the present study extend beyond parents to caregivers more broadly speaking.

Feasibility. The high rate of attrition suggests a major problem in the current study design. Future work should combine both portions of the study into to a single website to reduce participant effort, confusion, and inaccuracy. Attrition also introduced concerns of sample bias. Participants with lower health or computer literacy may have been more likely to give up and drop out during training. If health literacy or computer literacy impacted program completion, future monitoring may be required to ensure training completion for individuals with lower health or computer literacy. If parents are fatigued due to parenting responsibilities, the prospect of repeating training in the BST-M group, or figuring out computer-based problems (such as the link from SurveyMonkey to the training program not opening the correct browser due to a pop-up blocker) may also be daunting and have contributed to attrition.

Of note, the program requires access to a laptop or desktop computer. For a more diverse population to have easy access to the training, a mobile-friendly version is needed. In addition to the other small program modifications, future work should investigate the usability of the program on a smaller screen when not all sleep environment components may be viewed simultaneously.

Future work should also directly assess usability. Participants could be asked about difficulties with the program, questions that may have come up while completing the training, and thoughts on the effort and time required to complete the training. Again, given the high attrition, some participants may require monitoring to engage with the program. Identification of participant groups most likely to drop out of the study could direct future monitoring efforts.

Next Steps. Future research should investigate factors that may influence skill acquisition. The present study aimed to identify whether Health Literacy influenced skill acquisition; however, the limited range of Health Literacy scores and the homogenous make-up of the present sample prevented further analyses. If future research does find an interaction between Health Literacy and treatment group, a targeted literacy screener might be helpful in directing training group assignment.

Other parent or caregiver factors may also influence skill acquisition. For example, caregiver fatigue and distress or mental health concerns (e.g., depression and/or anxiety) could influence engagement with the program as well as skill acquisition speed. If participants are fatigued or distressed, they may overlook risks they could otherwise identify and avoid. Depression may impact motivation (e.g., Sherdell, Waugh, & Gotlib, 2012), resulting in poorer performance. Anxiety is associated with unsafe sleep behaviors (Austin, Nashban, Doering, & Davies, n.d.). Specifically, Austin and colleagues found that parent anxiety was associated with higher rates of bed-sharing behavior. Anxiety may impact engagement in the safe sleep behaviors recommended during the present training program. Future research should investigate what, if any, impact such other parental characteristics may have on skill acquisition, differential training effects, and changes in bed-sharing perceptions and intent. If future research finds differences based in these populations, treatments should be tailored and targeted for maximum benefit.

The present study provided training to parents who have likely already established a sleep routine for their infant. Future work should provide training prior to infant birth. A longitudinal study on a smaller sample could look at the effectiveness of the program over time, specifically assessing the initiation and maintenance of safe sleep behaviors. Home monitoring could investigate parent sleep environment preparation prior to the arrival of the infant, in the first week the infant is brought home, and then again 1 month, 3 months, 6 months, and 9 months post-infant birth. Such an intensive intervention might also provide the opportunity to ask parents about the practical difficulties they experience following the safe sleep guidelines. If necessary, a child sleep consultant could provide follow-up support to aid parent problem-solving as issues arise. For instance, if parents know their infants are supposed to sleep on their back, but they cry constantly when placed to sleep in this position, it would be beneficial for these parents to have support in finding ways to soothe the infants or learn self-calming strategies.

Non-traditional infant sleep surfaces and sleep products are becoming increasingly common (e.g., Doering & Salm Ward, 2017). Such products may not adhere to the AAP safe sleep guidelines. For example, air mattresses are inexpensive and portable; however, have been associated with 108 known infant sleep-related deaths from 2004 to 2015 (Doering & Salm Ward, 2017). Future research should explore specific training on sleep products and whether parents or caregivers can correctly identify whether sleep products adhere to the AAP safe sleep guidelines, regardless of product advertisement.

For the computerized safe sleep training used in the present study to be widely adopted and implemented, caregiver and provider buy-in is necessary. Future work could explore professionals' reactions to the training program as well. A clinic could begin piloting the training program with parents and gather feedback along the way, documenting strengths, challenges, and opinions.

Conclusion

The present study is a promising step in creating a brief, computer-based training program to teach parents how to create a sleep environment consistent with the AAP Safe Sleep Guidelines (2011). In a highly educated and health literate sample, there were no notable differences between treatment groups, suggesting Instructions Only may be effective with this sample. Overall, training resulted in significant improvements in safe sleep environment creation. Training also significantly improved parents' free-response identification of risks in pictures of infants sleeping. However, parents identified more risks when using a forced-choice checklist than when asked to provide unprompted responses. In fact, parents' identification of risks using the checklist did not significantly improve after training, likely due to the overall high pre-test scores. This suggests that in the present sample, a checklist may be used to aid in the identification of infant sleep risks.

To assess change in beliefs about the AAP Guidelines and future sleep environment creation because of training, parents were asked about the perceived safety of, and engagement in, bed-sharing. There was a significant reduction in the perceived safety of bed-sharing and reported bed-sharing plans after participants completed training. These results suggest that training may have not only resulted in significant gains in ability to create a safe sleep environment and identify sleep risks, but may have also resulted in associated changes in beliefs and safe sleep behaviors. Future work is needed to determine whether skills learned in training result in associated sleep environment changes at home.

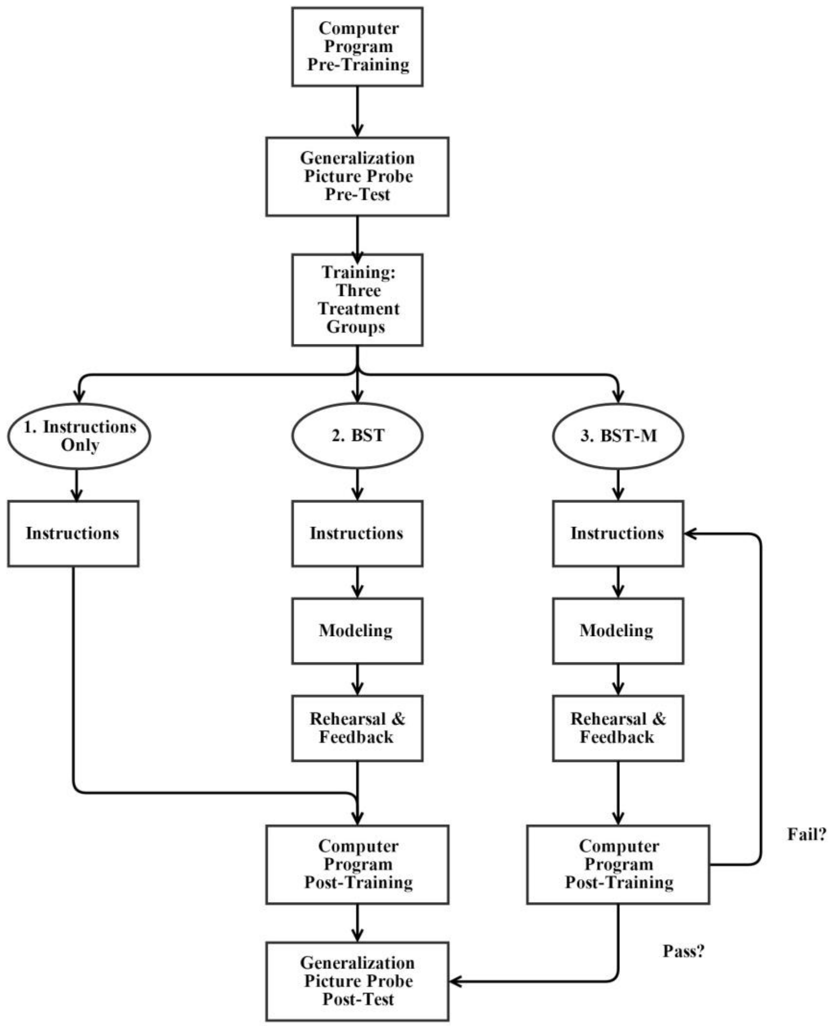
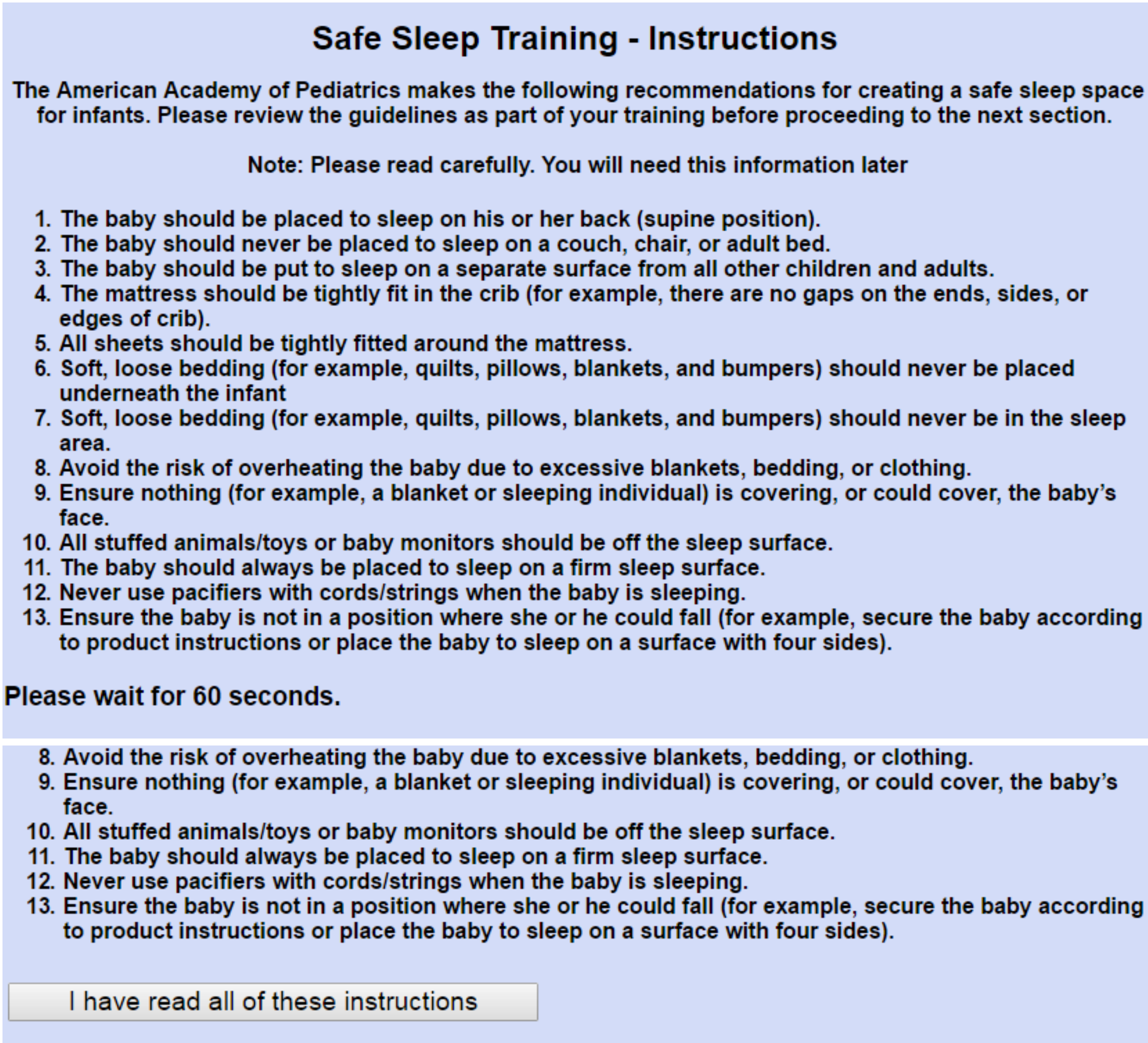


Figure 1. Experimental design including the three treatment conditions: Instructions Only (Instructions), Behavioral Skills Training (BST), Behavioral Skills Training to 100% Mastery (BST-M).



Safe Sleep Training - Instructions

The American Academy of Pediatrics makes the following recommendations for creating a safe sleep space for infants. Please review the guidelines as part of your training before proceeding to the next section.

Note: Please read carefully. You will need this information later

1. The baby should be placed to sleep on his or her back (supine position).
2. The baby should never be placed to sleep on a couch, chair, or adult bed.
3. The baby should be put to sleep on a separate surface from all other children and adults.
4. The mattress should be tightly fit in the crib (for example, there are no gaps on the ends, sides, or edges of crib).
5. All sheets should be tightly fitted around the mattress.
6. Soft, loose bedding (for example, quilts, pillows, blankets, and bumpers) should never be placed underneath the infant
7. Soft, loose bedding (for example, quilts, pillows, blankets, and bumpers) should never be in the sleep area.
8. Avoid the risk of overheating the baby due to excessive blankets, bedding, or clothing.
9. Ensure nothing (for example, a blanket or sleeping individual) is covering, or could cover, the baby's face.
10. All stuffed animals/toys or baby monitors should be off the sleep surface.
11. The baby should always be placed to sleep on a firm sleep surface.
12. Never use pacifiers with cords/strings when the baby is sleeping.
13. Ensure the baby is not in a position where she or he could fall (for example, secure the baby according to product instructions or place the baby to sleep on a surface with four sides).

Please wait for 60 seconds.

8. Avoid the risk of overheating the baby due to excessive blankets, bedding, or clothing.
9. Ensure nothing (for example, a blanket or sleeping individual) is covering, or could cover, the baby's face.
10. All stuffed animals/toys or baby monitors should be off the sleep surface.
11. The baby should always be placed to sleep on a firm sleep surface.
12. Never use pacifiers with cords/strings when the baby is sleeping.
13. Ensure the baby is not in a position where she or he could fall (for example, secure the baby according to product instructions or place the baby to sleep on a surface with four sides).

I have read all of these instructions

Figure 2. Instructions presented during training. Modified from the 2011 AAP Guidelines. The top panel shows the 60-s countdown which also prevented participants from navigating to the next page. The bottom panel shows the button that appears following the countdown. Participants were required to select the button stating, "I have read all of these instructions" prior to pressing the "Next" button.

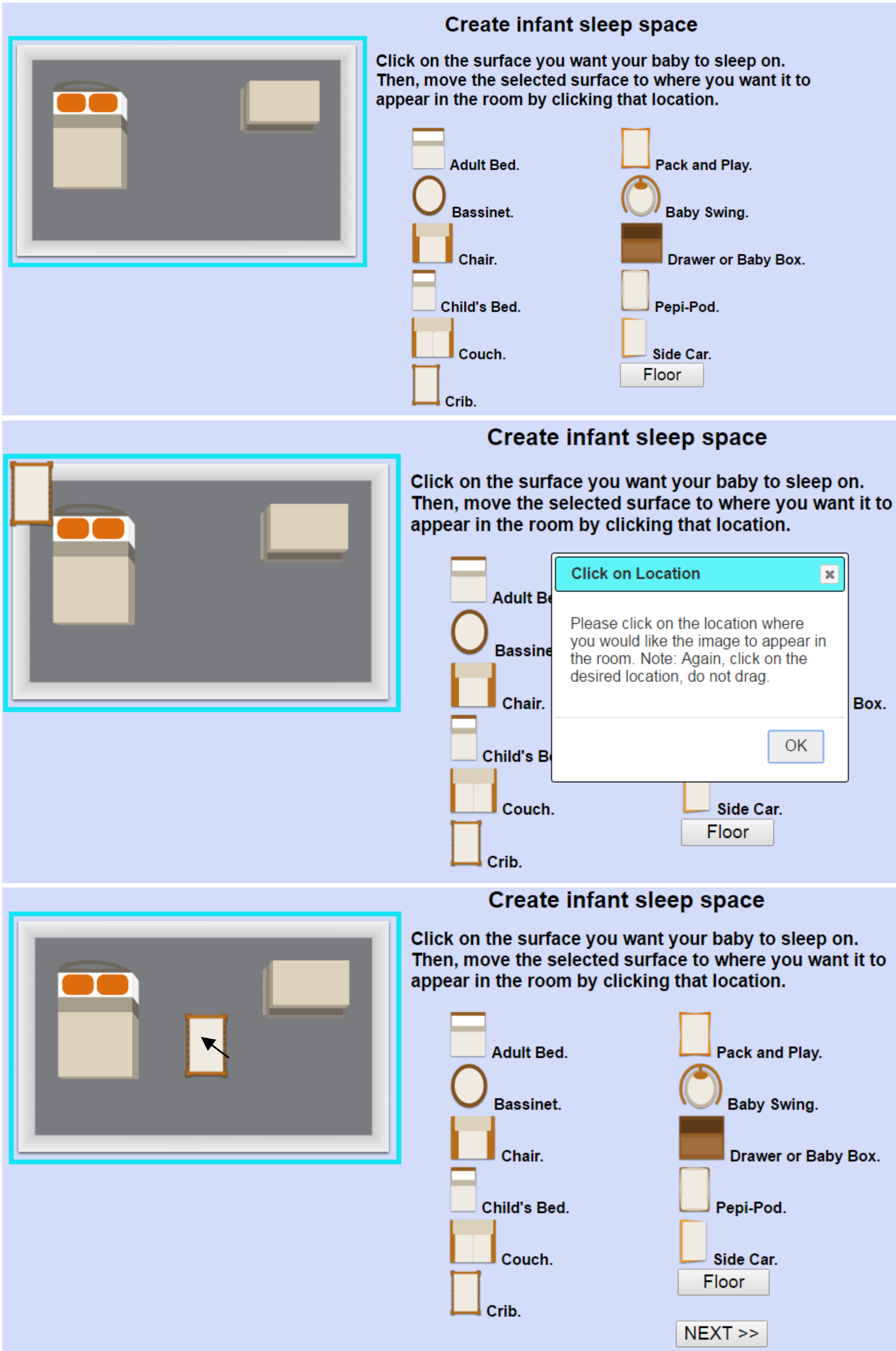


Figure 3. Creation of the computerized sleep environment. The top panel shows the question and response options. The middle panel shows how the image will appear in the top left corner of the room after selection and the instructions on how to place the object. The bottom panel shows how to point and click on the desired placement.

Figure 4. Free-response identification of risks on the generalization picture probe test. Participants enter their response in the text box, select "Submit Answer" and then move on.

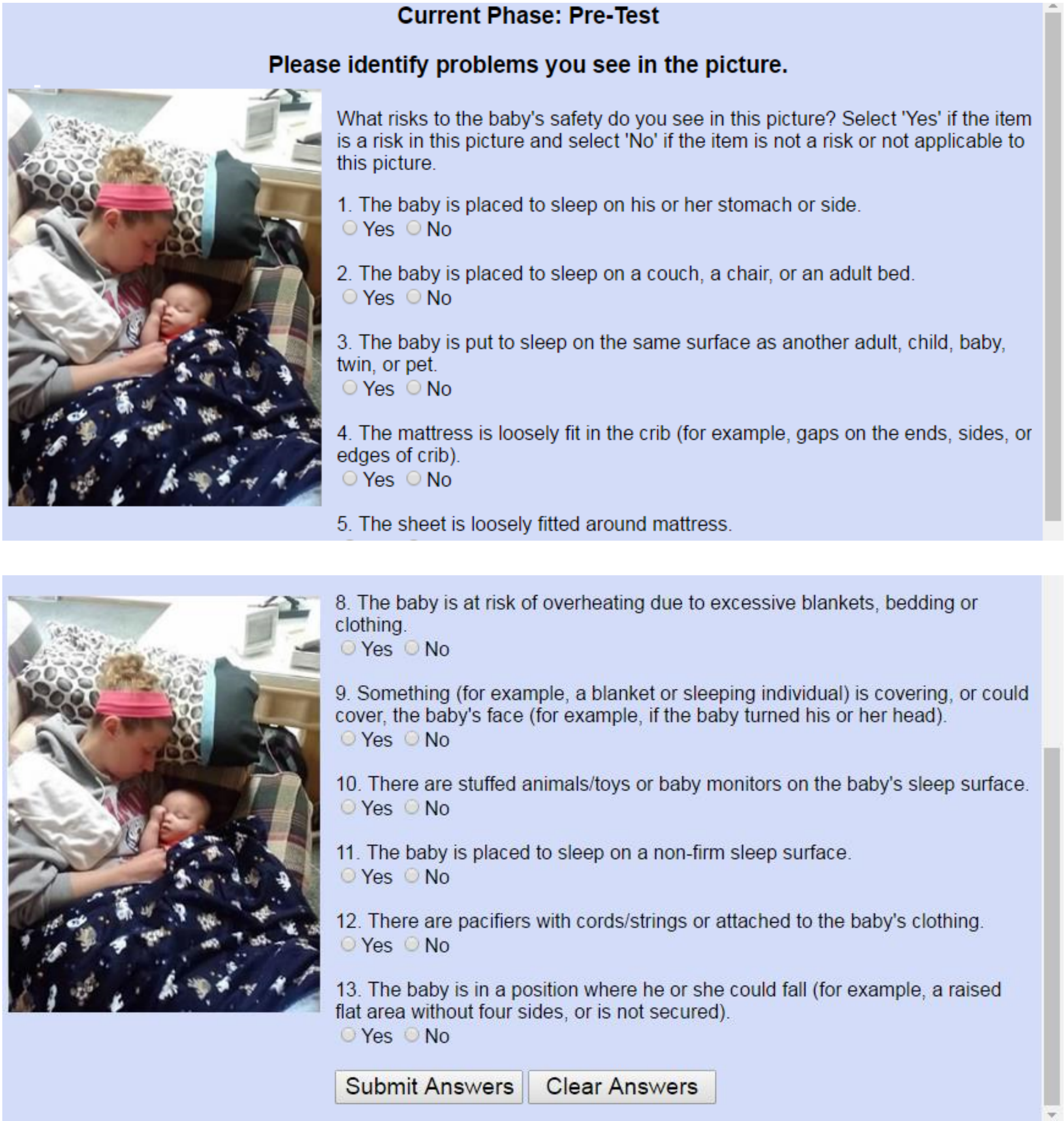


Figure 5. Checklist identification of risks on the generalization picture probe test. These panels show how participants will use their mouse to select "Yes" or "No" for each potential risk. Participants will also use their mouse to scroll down the page to see all of the items. However, the picture will scroll with the page so they do not need to rely on recall to answer any items.

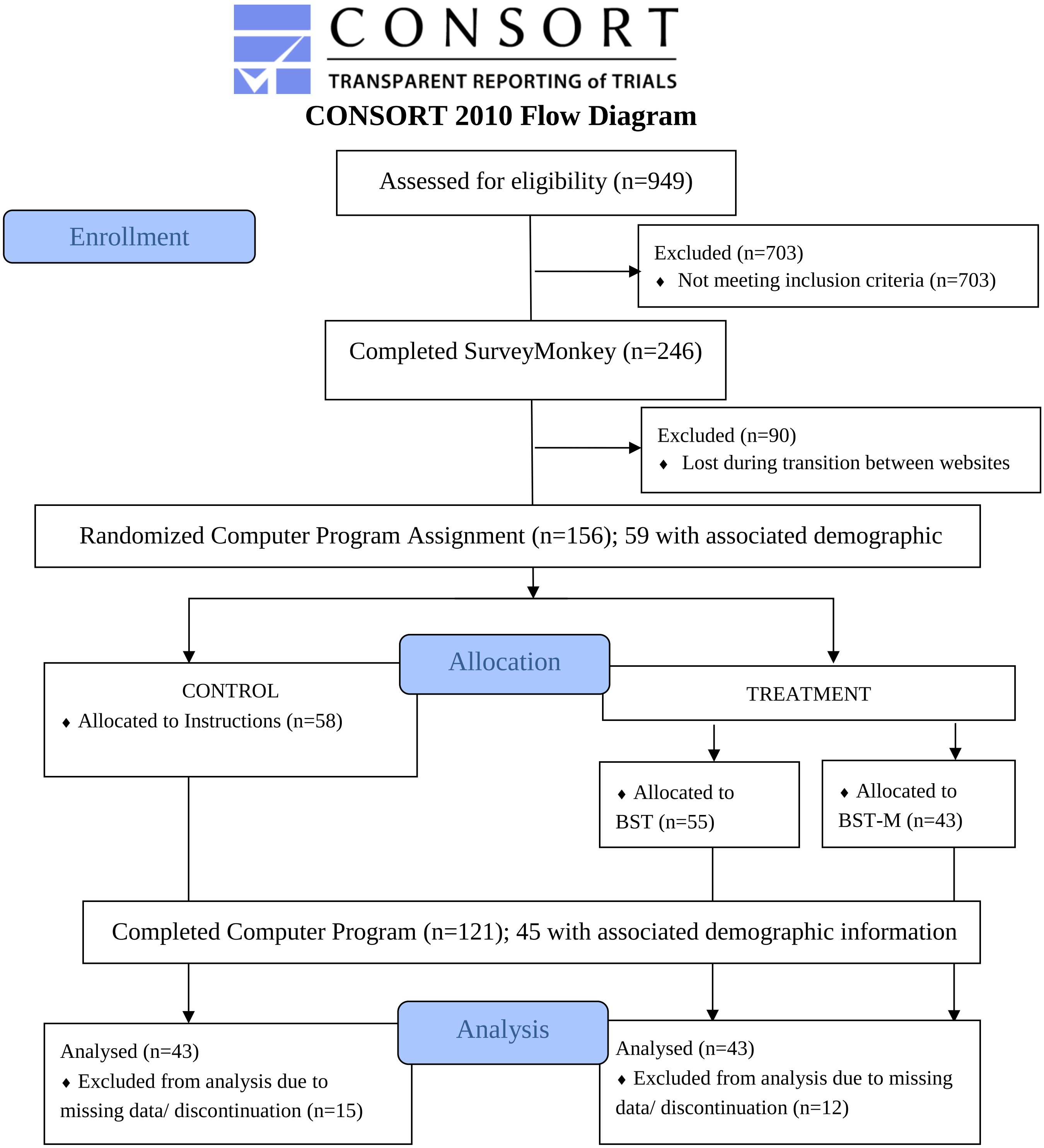


Figure 6. Flow diagram showing participant enrollment, allocation, analysis, and exclusion along with number of participants who have associated demographic information. Modified from CONSORT (2010).

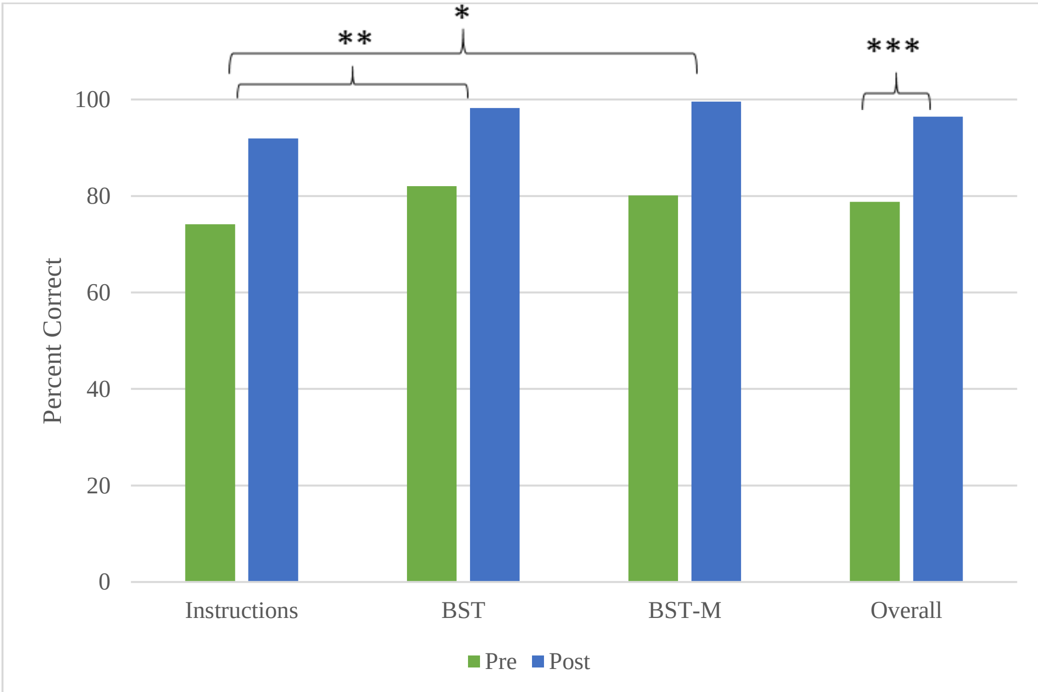


Figure 7. Percentage of correct responses on sleep environment creation. Pre-test, post-test, and combined scores are presented by treatment group. *n*=105; *p<.05; ** p<.01; *** p<.001.

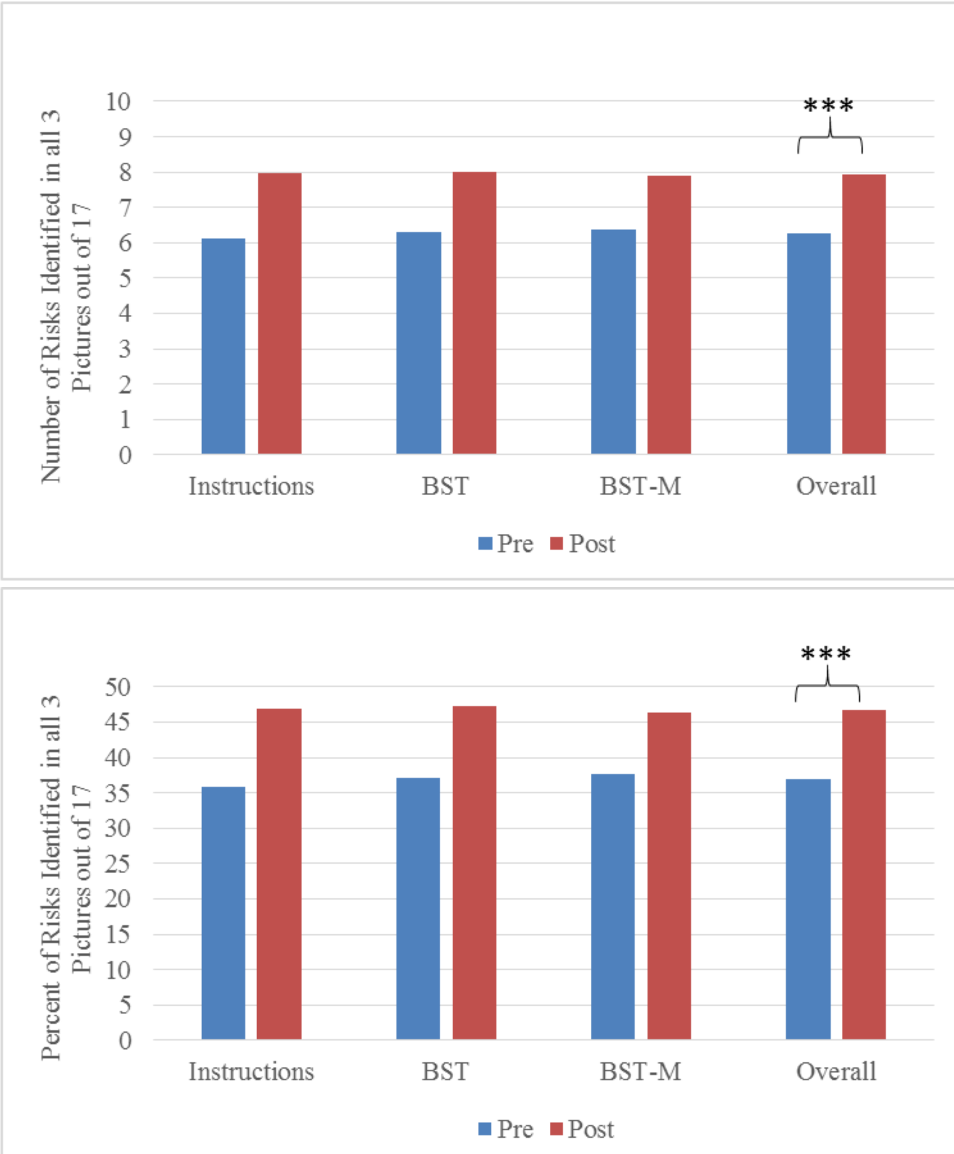


Figure 8. Correct free-response risks identified. The number is shown in the top panel and the percent is shown in the bottom panel. Graphs reflect the total correct free-response risks across all three pictures out of 17 total risks. Pre-test and post-test scores are presented by treatment group and overall. *n*=126. *** *p*<.001.

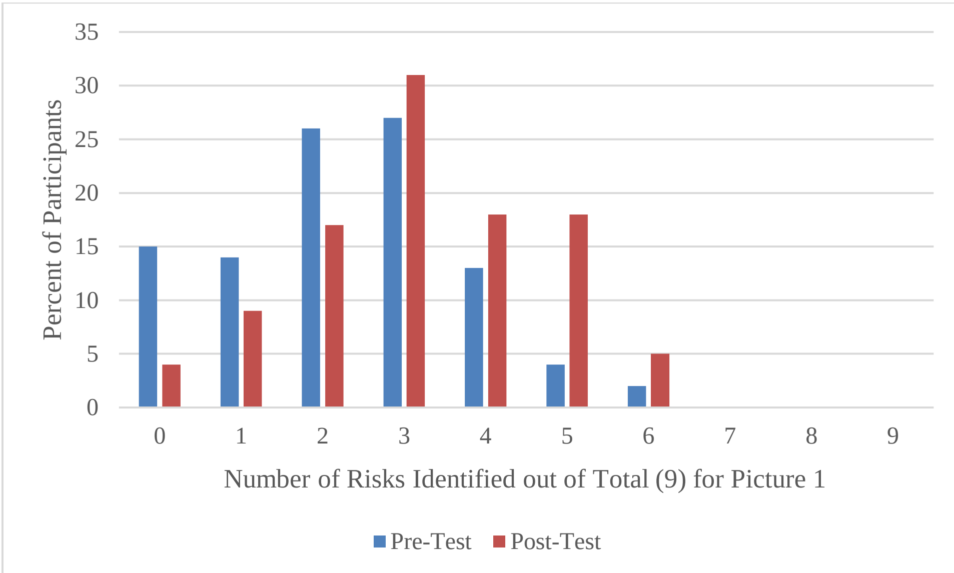


Figure 9. Percentage of participants who identified each number of risks out of 9 for Picture 1. *n*=126

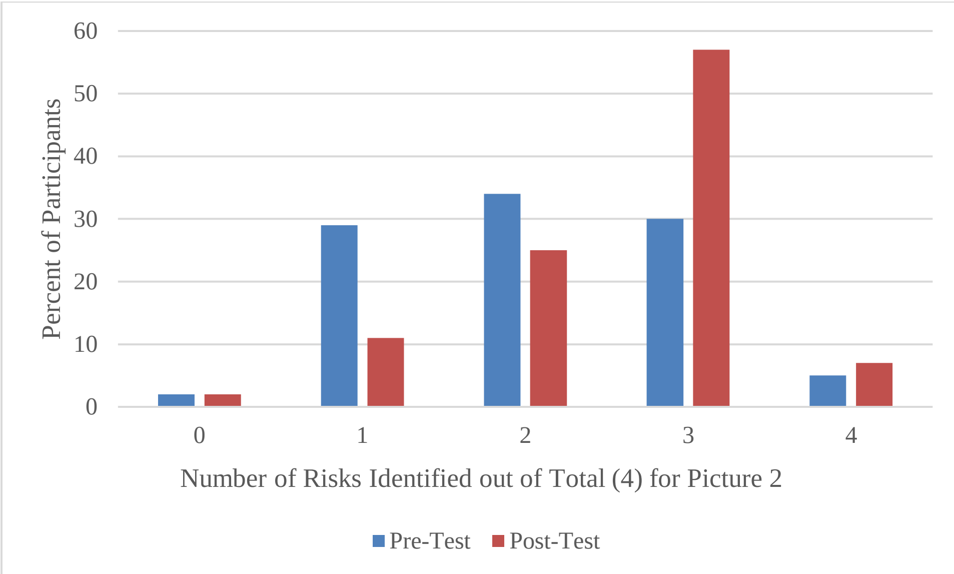


Figure 10. Percentage of participants who identified each number of risks out of 4 for Picture 2. *n*=126

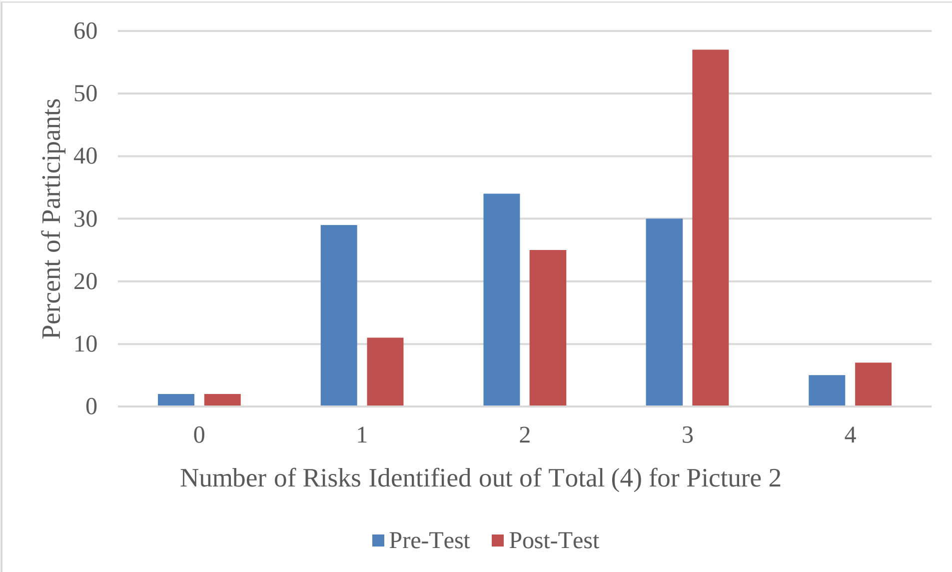


Figure 11. Percentage of participants who identified each number of risks out of 4 for Picture 3. *n*=126

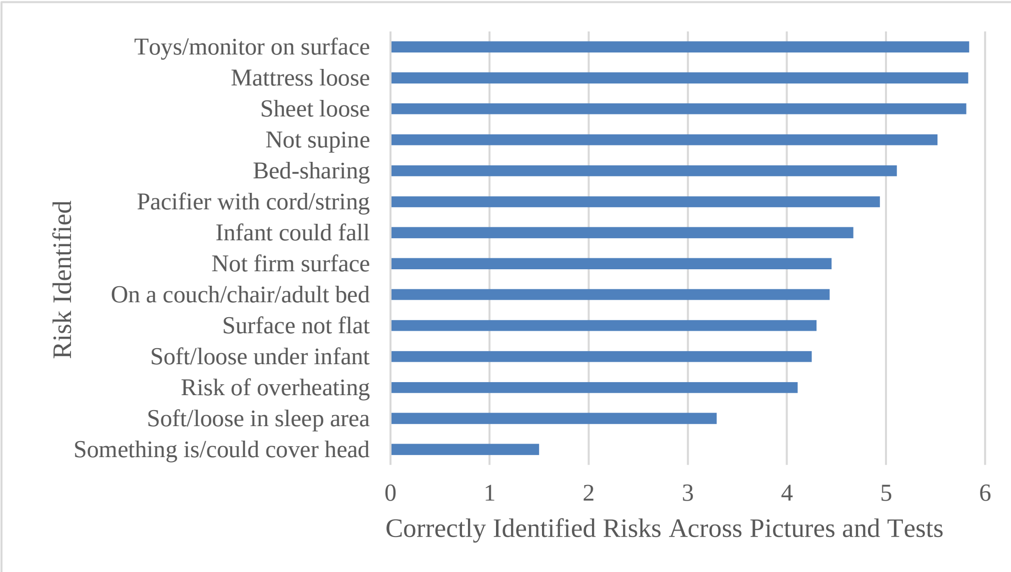


Figure 12. Number of correctly identified risks and omitted non-risks across all three pictures and pre- and post-tests.

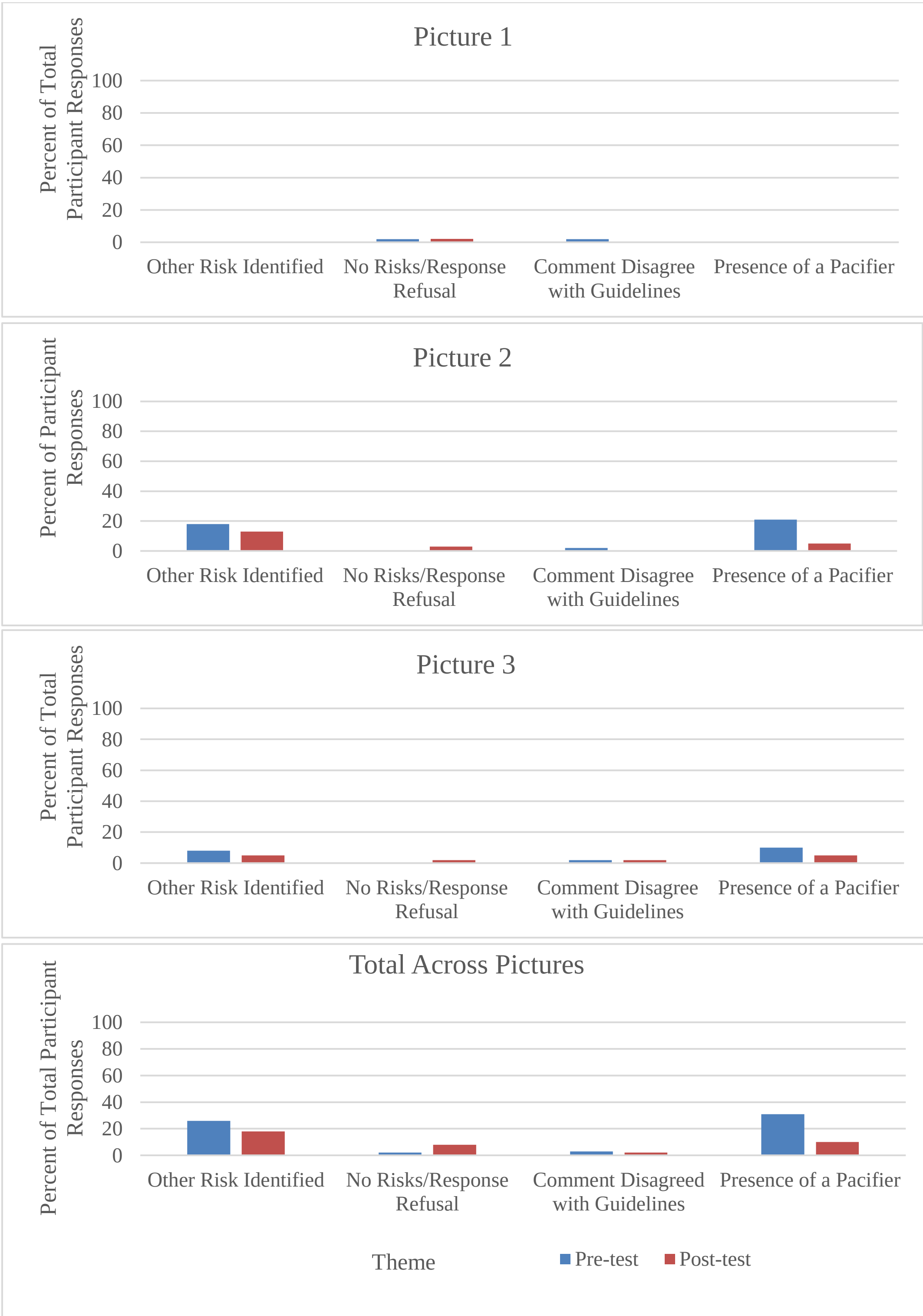


Figure 13. Free-response themes across pre- and post-test for all 61 “Other” responses. The top panel shows responses for Picture 1. The second panel shows responses for Picture 2. The third panel shows responses for Picture 3. The bottom panel shows responses across all pictures.

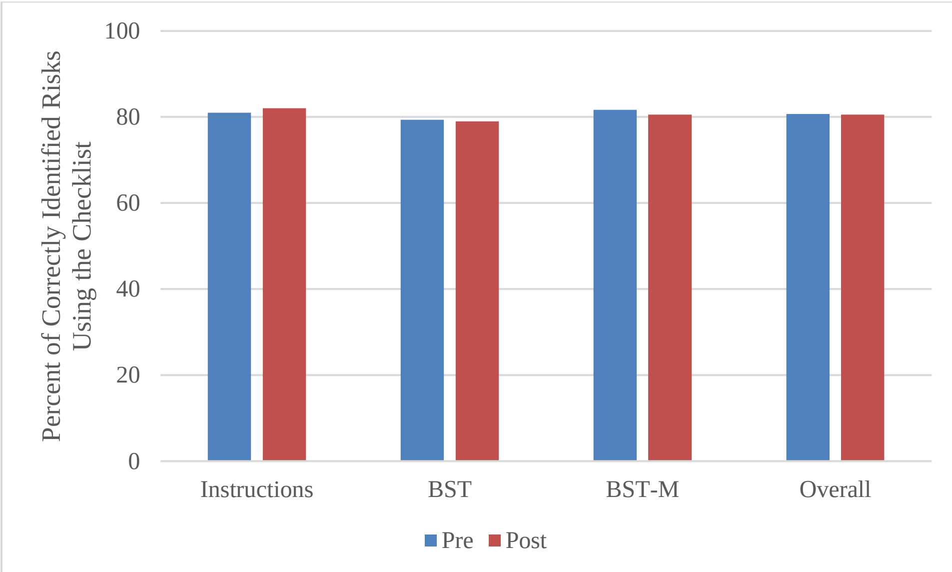


Figure 14. Percentage of total correctly identified risks from all three pictures from pre- to post-test by treatment group. *n*=120.

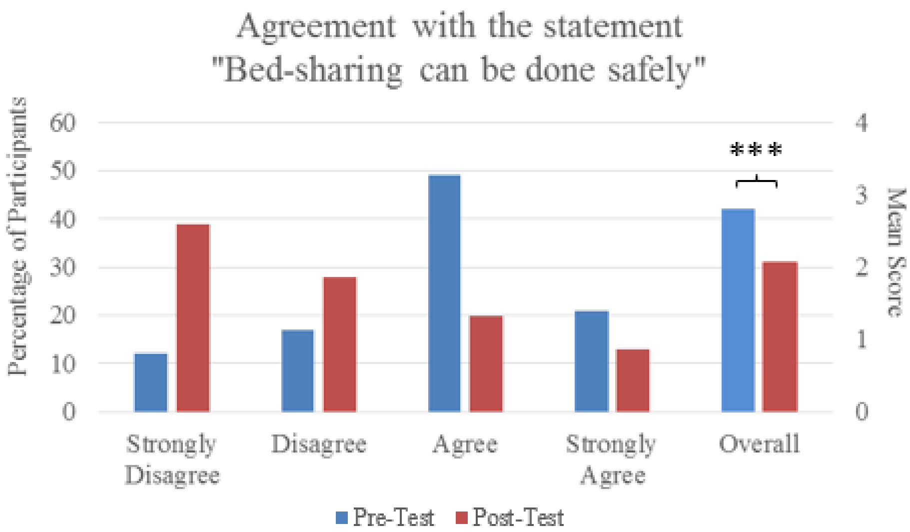


Figure 15. Participants' perceptions of bed-sharing safety. Percentage of participants reporting agreement is shown on the left y-axis. Mean Overall Likert score from 0-4 is shown on the right y-axis. n=150 for pre-test and 120 for post-test. ***p<.001

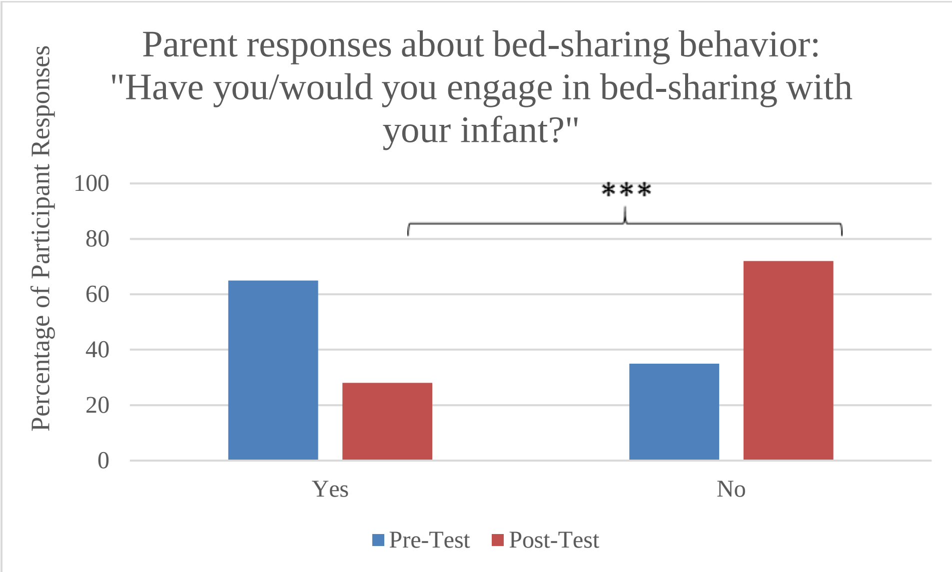


Figure 16. Participants' current bed-sharing behavior and bed-sharing intent. *n*=150 for pre-test and 120 for post-test. ***p<.001

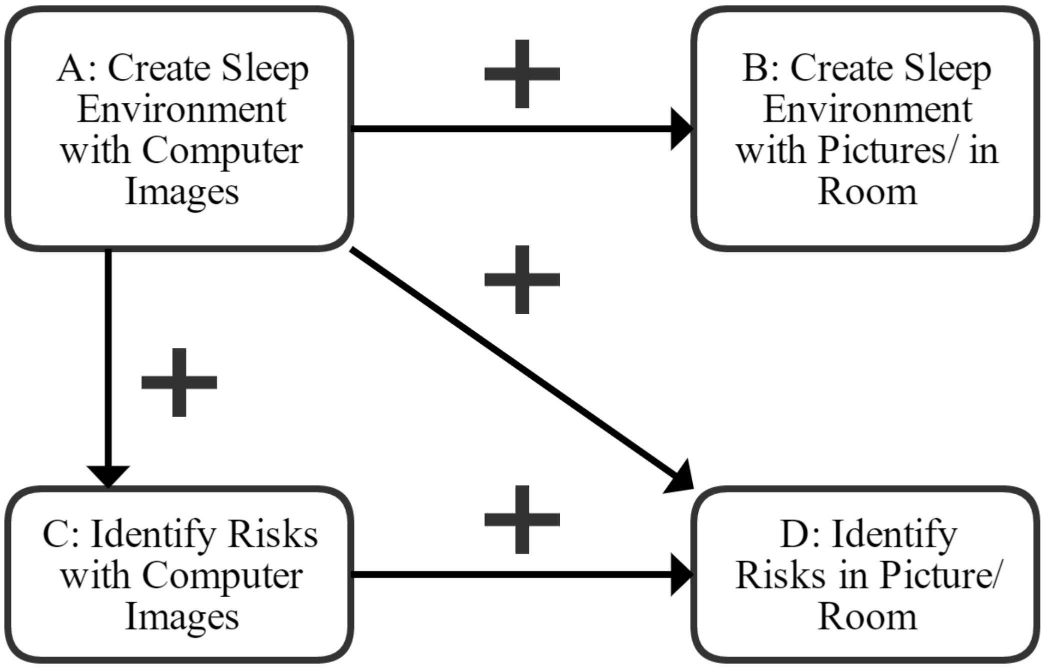


Figure 17. Proposed model to assess appropriateness of generalization tests. This model depicts the primary outcome measure, parents' creation of a safe sleep environment on a computer (A) and generalization tests, identifying risks in a picture (D) used in the present study. Other potential measures of generalization are proposed including creation of a sleep environment using pictures of images in a 3-dimensional computer program environment or in an actual room (B) as well as identification of risks using computer images (C). The +'s show hypothetical relationships which, if tested, would support the hypothesis that procedure D was an appropriate generalization test for skills demonstrated on A.

Note. Correlation between A and D for the present study was significant, r=.212, p<.05.

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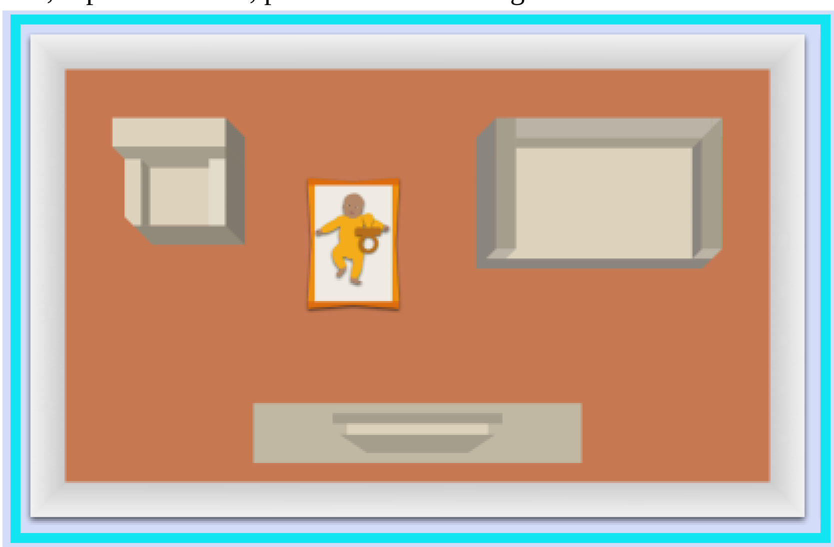
Appendix A

Behavioral Skills Training Package

1. The American Academy of Pediatrics makes the following recommendations for creating a safe sleep space for infants. Please review the guidelines as part of your training before proceeding to the next section. Note: You will need this information later.
    a. The baby should be placed to sleep on his or her back (supine position).
    b. The baby should never be placed to sleep on a couch, chair, or adult bed.
    c. The baby should be put to sleep on a separate surface from all other children and adults.
    d. The mattress should be tightly fit in the crib (for example, there are no gaps on the ends, sides, or edges of crib).
    e. All sheets should be tightly fitted around the mattress.
    f. Soft, loose bedding (for example, quilts, pillows, blankets, and bumpers) should never be placed underneath the infant.
    g. Soft, loose bedding (for example, quilts, pillows, blankets, and bumpers) should never be in the sleep area.
    h. Avoid the risk of overheating due the baby due to excessive blankets, bedding, or clothing.
    i. Ensure nothing (for example, a blanket or sleeping individual) is covering, or could cover, the baby's face.
    j. All stuffed animals/toys or baby monitors should be off the sleep surface.
    k. The baby should always be placed to sleep on a firm sleep surface.
    l. Never use pacifiers with cords/strings when the baby is sleeping.
    m. Ensure the baby is not in a position where she or he could fall (for example, secure the baby according to product instructions or place the baby to sleep on a surface with four sides).
2. Here are three examples of safe sleeping arrangements for an infant.
    a. Child bedroom, crib, firm, flat, no modifications, no bedding, swaddle, on back, separate surface, no toys, baby monitor outside sleep area.

b. Parent bedroom, bassinet, firm, flat, no modifications, no bedding, diaper only, on back, separate surface, no toys, baby monitor outside sleep area.

c. Living room, pack and play, firm, flat, no modifications, no bedding, long sleeve onesie, on back, separate surface, pacifier without string.



3. (Computer Program Training with Feedback) The below feedback will be used to educate parents on sleep arrangements. These were written primarily based on the AAP guidelines (2011) for creating a safe sleep environment. The feedback highlighted in red is scored as incorrect. The feedback highlighted in green is scored as correct. The feedback highlighted in gray is scored as neutral (neither correct nor incorrect).

    a. Will you be sleeping in the same room as your baby?

        i. Yes

            1. Will you be sharing the same sleep surface with your baby?

                a. Yes

        i. Wait! Sharing a sleep surface with your baby is dangerous. There is no evidence bed-sharing protects against sudden infant death syndrome (SIDS) or suffocation. Not all risks, such as caregiver fatigue, can be controlled. Sharing the same sleep surface can cause your baby to suffocate or be strangled, which may lead to death. Your baby should also not share a sleep surface with other infants or children.

    b. No

        i. Great job! Room-sharing without sharing the same sleep surface is recommended. There is evidence that this arrangement decreases the risk of sudden infant death syndrome (SIDS) by as much as 50%. It also makes feeding, comforting, and monitoring the baby easier while he or she sleeps.

ii. No

1. Room-sharing without sharing the same sleep surface may reduce the risk of sudden infant death syndrome (SIDS). It also makes feeding, comforting, and monitoring the baby easier while he or she sleeps.

b. Will the sleep surface be soft or firm?

i. Soft

1. Wait! Soft sleep surfaces, including couches, adult beds, and used baby mattresses increase the risk of sudden infant death syndrome (SIDS) and suffocation.

ii. Firm

1. Great job! A firm sleep surface is recommended to reduce the risk of sudden infant death syndrome (SIDS) and suffocation.

c. Will the sleep surface be flat or angled on an incline?

i. Inclined

1. Wait! Babies can suffocate if they are not placed to sleep on a flat surface. Nothing should be placed under the baby or the mattress/crib. If they are placed to sleep on an incline their heads can fall forward, which blocks their airway and prevents them from breathing. Inclining does not improve symptoms of reflux and is not recommended except in rare medical conditions.

ii. Flat

1. Great job! A flat surface is recommended to protect against suffocation.

d. Choose the surface your baby will sleep on (Choose one)

i. Couch

1. Wait! Couches are dangerous for babies as they could get stuck, strangled, or suffocate. Couches are a leading cause of sudden infant death syndrome (SIDS).

ii. Chair
    1. Wait! Chairs and recliners are dangerous for babies. For example, babies can easily fall. Babies can also suffocate from cushions or, if they are placed to sleep on an incline, their heads can fall forward, blocking their airway, preventing them from breathing
iii. Crib
    1. Great job! Cribs are one of the safest places for babies to sleep!
iv. Bassinet
    1. Great job! Bassinets are one of the safest places for babies to sleep!
v. Pack and play
    1. Great job! Pack and plays are one of the safest places for babies to sleep!
vi. Baby swing, bouncer, or car seat
    1. Wait! Swings, bouncers, and car seats are dangerous for sleeping babies. Babies could fall out or slump over, blocking their airway. Even when babies are secured, they could still suffocate because they are not placed to sleep on a flat surface. If they are placed to sleep on an incline their heads can fall forward, blocking the airway, preventing them from breathing. Car seats keep babies safe while they are traveling in cars, but they are not meant for sleeping, so babies should be moved to a safe sleep surface once you arrive to your destination.
vii. Floor
    1. Great job! Floors are flat and firm, which are both important in keeping babies safe. <u>But, it is important</u> to make sure you don't use soft barriers around the infant, as those can be suffocation hazards. Make sure that everyone knows the baby is sleeping on the floor so that no one steps on the baby.
viii. Adult bed
    1. Wait! Adult beds are dangerous for babies. They are too soft for an infant and modern bedding, including blankets, comforters, sheets, and pillows are suffocation hazards for babies. Even if bedding is removed, adult mattresses can still be dangerous because they are not firm or flat. Pillow-top mattresses, old mattresses, with depressions or indents, and waterbeds are all suffocation hazards. If your baby rolls onto his or her stomach in the night, your baby could suffocate.
ix. Child bed
    1. Wait! Child beds are dangerous for babies because of entrapment or suffocation. They are too soft for an infant and modern bedding, including blankets, comforters, sheets, and pillows, are all suffocation hazards for babies. Even if bedding is removed, a child mattress can still be dangerous. Pillow-top mattresses, old mattresses, with depressions or indents, and waterbeds are suffocation hazards. If your baby rolls onto his or her stomach in the night, your baby could suffocate.
x. Drawer

1. Great job! A dresser drawer is one of the safest places your baby can sleep. Drawers are firm and flat making them safe for a sleeping baby. Make sure there are no soft blankets or pillows in the drawer with your baby and make sure the drawer is placed on a firm and flat surface.

xi. Side car sleeper (baby bed that connects to the adult bed)

1. Wait! There is no safe barrier that prevents the baby from rolling into the adult bed, which is dangerous for babies. Beds are too soft for babies and modern bedding, including blankets, comforters, sheets, and pillows, are suffocation hazards. Even if bedding is removed, adult mattresses can be dangerous. Pillow-top mattresses, old mattresses with depressions or indents, and water beds are suffocation hazards.

xii. Pepi-pod

1. Wait! Devices promoted to make bed-sharing "safe" such as pepi-pods are not recommended. Research has <u>not</u> shown any bed-sharing situations that are protective against sudden infant death syndrome (SIDS) or suffocation.

e. How might you modify the sleep surface? What things might you add, remove, or change? (Choose any)

i. Divider

1. Wait! Attempts to separate the infant from others through the use of a divider is not recommended because dividers can trap the baby and cause strangulation or suffocation.

ii. In-bed sleeper

1. Wait! Devices promoted to make bed-sharing "safe" such as in-bed sleepers are not recommended. Research has <u>not</u> shown any bed-sharing situations that are protective against sudden infant death syndrome (SIDS) or suffocation.

iii. Positioner

1. Wait! Positioners, or other similar devices do not reduce the risk of sudden infant death syndrome (SIDS) or suffocation. Positioners <u>should only be used</u> if prescribed by a doctor for a rare medical condition.

iv. Wedge

1. Wait! Wedges or other similar devices do not reduce the risk of sudden infant death syndrome (SIDS) or suffocation. Using wedges to incline a baby does not improve symptoms of reflux and is not recommended except in rare medical conditions.

v. Remove pillows

1. Great job! Pillows can increase the risk of sudden infant death syndrome (SIDS) and suffocation in babies.

vi. Add pillows

1. Wait! Pillows or cushions should not be used as substitutes for mattresses or in addition to mattresses. Such a soft surface increases the risk of sudden infant death syndrome (SIDS) and suffocation.

vii. Bed against wall
    1. Wait! Placing your baby to sleep next to a wall to prevent them from rolling off is dangerous. Your baby may get stuck and suffocate. Babies should not sleep in beds or on any soft surface.
viii. Bed-rails
    1. Wait! Bed-rails should not be used with babies because they can cause entrapment or strangulation. Babies should not sleep in beds or on any soft surface.
ix. Pillows beneath sheet
    1. Wait! Soft materials or objects such as pillows, quilts, comforters, or sheepskins, even if covered by a sheet, should not be placed under a sleeping baby. Soft surfaces can increase the risk of sudden infant death syndrome (SIDS) and suffocation. Using pillows to put the baby on an incline is not recommended and does not improve symptoms of reflux.
x. Crib bumpers
    1. Wait! Bumpers can lead to a baby being suffocated, strangled, or trapped. Bumpers do not prevent injury in infants.

f. Choose the bedding you would like to use (Choose any)

i. Pillows
    1. Wait! Pillows or cushions can increase the risk of sudden infant death syndrome (SIDS) and suffocation.
ii. Comforter
    1. Wait! Comforters increase the risk of sudden infant death syndrome (SIDS) and can lead to suffocation.
iii. Blanket
    1. Wait! Blankets, including those made out of fleece or afghans increase the risk of sudden infant death syndrome (SIDS) and can lead to suffocation.
iv. Flat/Top Sheet
    1. Wait! Sheets actually increase the risk of sudden infant death syndrome (SIDS) and can lead to suffocation.
v. None
    1. Great job! Bedding increases the risk of sudden infant death syndrome (SIDS).

g. What will be the sleeping position for your baby?

i. On back (supine)
    1. Great job! To reduce the risk of sudden infant death syndrome (SIDS), always place your infant to sleep fully on their back! Make sure everyone who cares for your baby knows to put your baby on his or her back to sleep.
ii. On stomach (prone)
    1. Wait! Placing an infant to sleep on their stomach increases the risk of sudden infant death syndrome (SIDS).

iii. On side
    1. Wait! Placing an infant to sleep on their side increases the risk of sudden infant death syndrome (SIDS).

h. What will your baby wear? (Choose any)

    i. Swaddle
    ii. Onesie
    iii. Diaper only
    iv. Sleep sack
        1. (For All) In general, infants should be dressed with no more than 1 layer more than an adult would wear to be comfortable. Could your infant be at risk? Infants cannot change their body temperature easily and can overheat if too warm. There is an increased risk of sudden infant death syndrome (SIDS) with overheating. Signs of overheating include sweating, heavy breathing, damp hair, flushed cheeks, or a heat rash. Infant sleepwear should keep the infant at a comfortable temperature without covering the infant's head or causing a risk of trapping the infant.

i. Will there be any extra items in the room (for example, stuffed animals, mobiles, or a pacifier)?

    i. Yes
        1. Will the extra items be on the same surface as your baby?
            a. Yes
                i. Select the toys (choose any)
                    1. Stuffed animal (example: teddy bear)
                        a. Wait! Objects such as stuffed toys might present a suffocation or choking hazard.
                    2. Mobile
                        a. When using a mobile, make sure it is out of reach of the infant. Cords can be a choking hazard or result in suffocation or strangulation as your baby becomes more active.
                    3. Pacifier with cord
                        a. Wait! Pacifiers can protect against sudden infant death syndrome (SIDS), but cords should not be used due to the risk of strangulation.
                    4. Pacifier without cord
                        a. Great job! Pacifiers without a cord may reduce sudden infant death syndrome (SIDS).
            b. No

i. Although most toys could be suffocation or choking hazards, it is suggested that infants use pacifiers without cords during sleep. Studies have reported a protective effect of pacifiers on the reducing sudden infant death syndrome (SIDS).

ii. No

1. Although most toys could be suffocation or choking hazards, it is suggested that infants use pacifiers without cords during sleep. Studies have reported a protective effect of pacifiers on the reducing sudden infant death syndrome (SIDS).

j. Will there be any type of baby monitor (for example, a heart or breathing cardiorespiratory monitor) in the sleep space that has not been prescribed by your doctor?

i. Yes

1. Will the monitor be on the same sleep surface as the baby?

a. Yes

i. Wait! Monitors can cause a baby to suffocate or choke. They should not be on the same surface as the infant or should not be used.

b. No

i. Monitors have not been shown to prevent sudden infant death syndrome (SIDS). If one is used, it should be on a separate sleep surface.

ii. No

1. Monitors have not been shown to prevent sudden infant death syndrome (SIDS).

Appendix B

Generalization Picture Tests

Part 1: We want to know if parents can identify safety risks found in baby sleep spaces. Please identify problems you see in the picture.

Part 2: What risks to the baby's safety do you see in this picture? Select 'Yes' if the item is a risk in this picture and select 'No' if the item is not a risk or not applicable to this picture.'

1. The baby is placed to on a non-flat surface and/or on his or her stomach or side. Yes/No
2. The baby is placed to sleep on a couch, a chair, or an adult bed. Yes/No
3. The baby is put to sleep on the same surface as another adult, child, baby, twin, or pet. Yes/No
4. The mattress is loosely fit in the crib (for example, gaps on the ends, sides, or edges of crib). Yes/No
5. The sheet is loosely fitted around the mattress. Yes/No
6. Soft, loose bedding (for example, quilts, pillows, blankets, bumpers, loose couch pillows) are placed underneath the baby. Yes/No
7. Soft, loose bedding (for example, quilts, pillows, blankets, bumpers, loose couch pillows) is in the sleep area. Yes/No
8. The baby is at risk of overheating due to excessive blankets, bedding or clothing. Yes/No
9. Something (for example, a blanket or sleeping individual) is covering, or could cover, the baby's face (for example, if the baby turned his or her head). Yes/No
10. There are stuffed animals/toys or baby monitors on the sleep surface. Yes/No
11. The baby is placed to sleep on a non-firm sleep surface. Yes/No
12. There are pacifiers with cords/strings or attached to the baby's clothing. Yes/No

13. The baby is in a position where he or she could fall (for example, a raised flat area without four sides, or is not secured). Yes/No

Picture 1:

Picture 2:

Picture 3:

Appendix C

Safe Infant Sleep Checklist

- ☐ The baby is placed to sleep on a flat surface and on his/her back.
- ☐ The baby is **not** placed to sleep on a couch, a chair, or an adult bed.
- ☐ The baby is **not** put to sleep on the same surface as another adult, child, baby, twin, or pet.
- ☐ The mattress is tightly fit in the crib (for example, no gaps on the ends, sides, or edges of crib).
- ☐ The sheet is tightly fitted around the mattress.
- ☐ Soft, loose bedding (for example, quilts, pillows, blankets, bumpers, loose couch pillows) are **not** placed underneath the baby.
- ☐ Soft, loose bedding (for example, quilts, pillows, blankets, bumpers, loose couch pillows) are **not** in the sleep area.
- ☐ The baby is **not** at risk of overheating due to excessive blankets, bedding or clothing.
- ☐ Nothing (for example, a blanket or sleeping individual) is covering, or could cover, the baby's face (for example, if the baby turned his or her head).
- ☐ Remove all stuffed animals/toys or baby monitors from the sleep surface.
- ☐ The baby is placed to sleep on a firm sleep surface.
- ☐ Remove cords/strings from the sleep environment and detach and remove pacifier cords.
- ☐ Ensure the baby is **not** in a position where he or she could fall (for example, a raised flat area without four sides, or a surface that is not secured).

Curriculum Vitae

Jillian (McCance) Austin, MS, BCBA

Educational History

University of Wisconsin-Milwaukee, Milwaukee, Wisconsin 2012-Present
Majors: Experimental Psychology; Behavior Analysis and Health Psychology
Minor: Psychopathology
PhD Expected: May, 2017
GPA: 4.0
Dissertation: A technology-aided approach to teaching parents to create a safe infant sleep space.
Advisor: W. Hobart Davies, PhD

University of Wisconsin-Milwaukee, Milwaukee, Wisconsin 2012-2014
Major: Psychology; Behavior Analysis
Degree: M.S., December 2014
GPA: 4.0
Thesis: Using alternative reinforcers to facilitate tolerance to delayed reinforcement following functional communication training.
Advisor: Jeff Tiger, PhD, BCBA-D

Earlham College, Richmond, Indiana 2004-2008
Major: Psychology
Degree: B.A., May 2008
Senior Thesis: Trust, communication, and commitment in long-distance relationships.
Advisor: Kathy Milar, PhD

Licensure and Certifications

Licensed Behavior Analyst, State of Wisconsin (number 128-140)

Board Certified Behavior Analyst (number 1-15-20095)

Journal Editorial Activities

Ad hoc reviewer for: Journal of Autism and Developmental Disorders

Junior ad hoc reviewer for: Journal of Pediatric Psychology

Clinical Positions

Aurora Health Care, Psychometrist, Grafton/Milwaukee, WI (2015-Present).
Duties: Administer and score psychological and neuropsychological assessments for children and adults. (Information on specific tests administered and scored listed below). Write behavioral

observations and discuss case conceptualization with supervising neuropsychologist.
Supervisors: Jessica Chapin, PhD, Gregory Wochos, PhD, and Joe Cunningham, PhD.

Children's Hospital of Wisconsin, Psychology Extern, Milwaukee, WI (2015-Present). Duties: Conduct pediatric feeding intake assessments and gain knowledge and experience working with genetic conditions in a multi-disciplinary setting with a gastroenterologist, speech therapist, and dietitian. Provide behavioral therapy and parent training for children with feeding disorders and toileting issues. Use cognitive behavioral therapy and biofeedback to treat children with anxiety disorders. Participate in weekly practicum didactic seminars and case presentations.
Supervisors: Alan Silverman, PhD; Andrea Begotka, PhD, and Meghan Wall, PhD, BCBA.

The Center for Autism Treatment, Board Certified Behavior Analyst, Mequon, WI (2014–2016). Duties: Develop behavior intervention plans, write and implement treatment programming based on the ABBLS-R, conduct functional behavioral assessments, create and lead group parent training sessions, complete monthly progress reports, graph clients' progress, participate in group supervision at weekly senior team meetings, and submit prior authorization information to obtain insurance coverage for behavior analysis services. Provide one-on-one applied behavior analytic therapy, emphasizing Skinner's analysis of verbal behavior for children with autism spectrum disorders. Teach communication skills across verbal operants, reduce problem behavior through teaching functional alternatives, and implement intensive table teaching using discrete trial training.
Supervisor: Tamara Kasper, MS, CCC-SLP, BCBA.

The Tiger Center for Applied Behavior Analysis Services, Therapist, Milwaukee, WI (2012–2014). Duties: Treated children with developmental disabilities and extreme problem behaviors including property destruction, aggression, and self-injury using applied behavior analysis principles and presented case updates in group supervision at weekly practicum meetings. Transitioned effective treatments to caregivers using behavioral skills training. Conducted research evaluating the efficacy of treatment interventions and modified procedures to decrease problem behaviors, increase functional skills, and improve overall quality of life.
Supervisor: Jeff Tiger, PhD, BCBA-D.

Casa de los Ninos, Care Coordinator and Project Specialist, Tucson, AZ (2010-2012). Duties: Coordinated behavioral health services to children with CPS involvement. Facilitated team meetings, trained caregivers on behavior management procedures, and implemented behavioral interventions to children and their families in the home, school, and community. Served as training coordinator, participated in the customer service and cultural competency committees.
Supervisor: Anne Cornell, MA, LPC.

La Frontera Center Inc., Child and Family Facilitator, Tucson, AZ (2008-2010). Duties: Provided case management services, including treatment plan development, to children with mental health diagnoses. Implemented behavioral interventions with children and families.

Conducted descriptive functional behavioral assessments, created individualized service plans, and formulated crisis and safety plans. Developed and led an autism social skills group for children. Participated in the Division of Developmental Disabilities and Behavioral Health Team committees.
Supervisor: Rita Jackson-Mullen, MA, LPC.

Jewish Community Center, Camp Chaverim Unit Head and Camp Counselor/Behavioral Aid, Columbus, Ohio (Summers 2007-2008). Duties: Oversaw counselors in their supervision of children at a day camp. Provided direct supervision of and behavior management to three children with autism.

Children's Crisis Treatment Center, Behavioral Health Technician and Therapy Intern; Philadelphia, PA (2007). Duties: Assisted in facilitation of play, dance, music, art therapies for low-income, high-risk children 3- to 5-years-old with behavioral health diagnoses. Participated in clinical staff meetings and created and implemented an all-program therapeutic art project.

Easter Seals of Southeastern Pennsylvania, Intern; Philadelphia, PA (2007). Duties: Assisted teacher with daily lessons and supervision in autism support classroom for children 3-6 years old. Designed and lead educational lessons.

The Ohio State University Rape Education and Prevention Center, Intern; Columbus, OH (2003-2004). Duties: Assist staff in providing support to victims of rape and sexual assault and provide general student population information on awareness and prevention.

Douglas Elementary School, Intern; Columbus, OH (2001-2002). Duties: Assist classroom teacher in daily lessons and supervision of students.

Training and Supervision Experience

University of Wisconsin, Milwaukee, 2012-Present. Duties: Supervise undergraduate research assistants in qualitative coding, development of senior research theses, and McNair Scholar research projects. Provide training on qualitative research methods, manuscript preparation, and presentation development to undergraduate researchers and junior colleagues.

The Center for Autism Treatment, 2014-2016. Duties: Train new employees on policies, procedures, and standard interventions used. Provide weekly supervision on treatment implementation and provide on-site training and feedback using behavioral skills training. Develop parent training curriculum and lead individual and group parent training on the principles of behavior analysis, behavior management using standardized procedures, and ways to problem-solve challenging behaviors in children with autism.

The Tiger Center for Applied Behavior Analysis Services, 2012-2014. Duties: After developing an effective intervention for children with severe problem behavior, provided parent and caregiver training on the implementation of behavior management procedures. Taught essential general behavior management to assist with problem-solving new behaviors.

Casa de los Ninos, 2010-2012. Duties: Provided parent, teacher, and employee training on functions of behavior, ways to increase positive behaviors and decrease negative behaviors in children, new employee orientation for all behavioral health workers, specialized in-service trainings on motivational interviewing, behavioral interventions, crisis and safety plan development, and writing insurance-compliant treatment plans. Supervised a team of behavioral health case managers providing services to children with complicated medical histories and child protective involvement and provided weekly individual case consultation and supervision.

La Frontera Center Inc., 2008-2012. Duties: Served as the agency's behavioral interventions coach and lead trainer to all staff. Developed agency's autism spectrum disorders training. Coached caregivers on creating household rules, de-escalating family conflict, and implementing structure into their daily routines.

Research Positions

Research Assistant, Child Stress and Coping Lab, University of Wisconsin-Milwaukee, September 2014-Present. Duties: Develop and lead clinical research in the field of pediatric psychology including projects related to safe infant sleep environments, perceptions of individuals with chronic illnesses, engagement in the choking game, reactions to chronic illness disclosure, and ways of enhancing social support to those with various serious illnesses. Manage weekly research team meetings, participate in lab writing team meetings, oversee the coding of qualitative data, and mentor undergraduates on their senior research theses under the supervision of W. Hobart Davies, PhD.

Project Assistant, Tiger Behavior Analysis Research Lab, University of Wisconsin-Milwaukee, August 2012- May 2014. Duties: Developed and executed clinical research projects with children who had extreme problem behaviors including property destruction, aggression, and self-injury. Conducted functional behavioral assessments and functional analyses, implemented treatment protocols, and trained caregivers to apply new procedures under the supervision of Jeff Tiger, PhD, BCBA-D.

Research Coordinator, Tucson Alliance for Autism, 2011-2012. Duties: Developed and implemented social communication research study with teens and young adults with autism spectrum disorders. Investigated the efficacy of social communication groups using the Vineland-II Adaptive Behavior Scale. Created a social communication survey, recruited participants, administered surveys, and interpreted results under the supervision of Principal Investigator, Kacey Chandler, PhD.

Research Assistant, University of Arizona, Department of Psychology, Psychophysiology Laboratory, January 2009-December 2009. Duties: Conducted research assessing correlations between depression and vagal tone. Examined and scored electrocardiographic data for Principal Investigator, John B. Allen, PhD.

Grant Research Support

Sigma Xi, $1,000 Grant-in-Aid of Research (2016)

University of Wisconsin, Milwaukee, $3,178 Department of Psychology Summer Research Fellowship (2015)

University of Wisconsin, Milwaukee, $1,000 John and Lynn Schiek Research Grant in Behavior Analysis (2013)

Grants, Honors, & Awards

University of Wisconsin, Milwaukee, Advanced Opportunity Program Fellowship (2015-2016; 2016-2017)

University of Wisconsin, Milwaukee, UWM Graduate School Graduate Student Travel Support Grant (Spring, 2013; Fall, 2013; Spring, 2014; Spring 2015; Spring 2016; Fall 2016)

Wisconsin Association for Behavior Analysis, Student Poster Competition Winner (August, 2014)

University of Wisconsin, Milwaukee, Distinguished Graduate Student Fellowship (Awarded based on scholarly accomplishments, undergraduate and graduate grades, letters of recommendation, and GRE scores; 2014-2015)

Society for the Advancement of Behavior Analysis Senior Student Presenter Grant (2014)

University of Wisconsin, Milwaukee, John and Lynn Schiek Stipend in Behavior Analysis (2012-2013; 2013-2014)

Phi Beta Kappa (2008)

Earlham College Psychology Department Research Honors (Admitted based on senior research paper; 2008)

Earlham College, Honors (GPA 3.0 or higher throughout academic enrollment; 2004-08)

Earlham College, Academic Scholarship (ACT score 25 or higher and GPA maintained at 3.5 or higher; 2004-08)

Earlham College, Scholar Athlete Award (3.0 GPA or higher during semester playing collegiate sports; 2004-05)

National Football Association Student Athlete Scholarship (Awarded for high school academic excellence and leadership on and off athletic team; 2004)

Teaching and Research Assistantships

University of Wisconsin, Milwaukee, Department of Psychology, Project Assistantship, Semester 1-2, 2012-2014.

Earlham College, Teaching Assistant/Practicum, Personality Psychology, Semester 1, 2007.

Earlham College, Teaching Assistant, Introduction to Psychological Perspectives, Semester 1, 2006.

Publications

Austin, J. E., Zinke, V. L., & Davies, W. H. (2016). Influencing Perceptions about Children with Autism and their Parents Using Disclosure Cards. *Journal of Autism and Developmental Disorders, 46*(8), 2764-2769. doi: 10.1007/s10803-016-2821-6

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Defenderfer, E. K., **Austin, J. E.,** & Davies, W. H. (2015). Current characteristics of the choking game on YouTube. *Global Pediatric Health*, 1-6. doi: 10.1177/2333794X15622333

Symposia Presentations

Austin, J. E. (2017, January). *Reducing sleep-related infant death: Promoting caregiver compliance with the American Academy of Pediatrics' safe sleep guidelines*. Invited presentation at Nationwide Children's Hospital, Columbus, OH.

McCance, J. E., & Tiger, J. H. (2014, May). *Using alternative reinforcers to facilitate delay tolerance following FCT*. Invited presentation at the Association for Behavior Analysis International Conference, Chicago, IL. Also presented at the Wisconsin Association for Behavior Analysis Roadshow (Eau, Claire, WI), the University of Wisconsin-Milwaukee Behavior Analysis Colloquia Series, (Milwaukee, WI), and the Wisconsin Association for Behavior Analysis Conference (Madison, WI).

McCance, J. E., & Tiger, J. H. (2013, February). *Prompted engagement with matched stimuli reduces self-injurious behavior.* Invited presentation at the Behavior Analysis Colloquia Series, University of Wisconsin-Milwaukee, Milwaukee, WI.

McCance, J. E., & Tiger, J. H. (2013, October). *Evaluation of matched stimulation in the treatment of problem behavior: Matching by type and location.* Invited presentation at the Behavior Analysis Colloquia Series, University of Wisconsin-Milwaukee, Milwaukee, WI.

McCance, J. E. (2008, April). *Trust, communication, and commitment in long-distance relationships.* Invited presentation at the Mid-America Undergraduate Psychology Research Conference, Thomas More College, Crestview Hills, KY.

International Conference Presentations

Austin, J. E., & Kasper, T. S. (2016, May). *Reducing problem behavior in a peer group setting using differential reinforcement of other behavior*. Presented at the Association for Behavior Analysis International Conference, Chicago, IL.

McCance, J. E., & Tiger, J. H. (2013, May). *Prompted engagement with matched stimuli reduces self-injurious behavior.* Presented at the Association for Behavior Analysis International Conference, Minneapolis, MN.

National Conference Presentations

Austin, J. E., Lopez, L., & Davies, W. H. (2017, April). *Predictors of compliance with and reactions to the American Academy of Pediatrics' safe sleep guidelines.* Presented at the Society of Pediatric Psychology Annual Conference, Portland, OR.

Galijot, R., **Austin, J. E**., & Davies, W. H. (2017, April). *Disclosure of chronic pediatric conditions: Evaluating parental autism disclosure strategies*. Presented at the Society of Pediatric Psychology Annual Conference, Portland, OR.

Defenderfer, E.K., Igler, E., **Austin, J.E**., & Davies, W.H. (2017, April). *Parent compliance with AAP toilet training recommendations and the role of primary care providers*. Presented at the Society of Pediatric Psychology Annual Conference, Portland, OR.

Sowinksi, B., Igler, E.C., **Austin, J.E**, Defenderfer, E.K., Davies, W.H. (2017, April). *Healthy friends' acceptance of a potential standardized message to promote social support for children diagnosed with a chronic illness*. Presented at the Society of Pediatric Psychology Annual Conference, Portland, OR.

Austin, J. E., Nashban, C. J., Doering, J. J., Defenderfer, E. K., & Davies, W. H. (2015, April). *Is parental functioning associated with the likelihood of bed-sharing?* Presented at the Society of Pediatric Psychology Annual Conference, San Diego, CA.

McCance, J. E., Tiger, J. H., & Peplinski, C. S. (2014, March). *Evaluation of matched stimulation in the treatment of problem behavior: Matching by type and location.* Presented at the Association of Professional Behavior Analysts, New Orleans, LA.

Regional Conference Presentations

Austin, J.E., Zinke, V. L., & Davies, W. H. (2016, November). *Influencing perception about children with autism and their parents using an autism disclosure card*. Presented at the Ohio Center for Autism and Low Incidence Conference, Columbus, OH.

Zinke, V. L., **Austin, J. E.,** & Davies, W. H. (2015, July). *The impact of autism disclosure on public perceptions: Gender differences.* Presented at the Wisconsin McNair Research Symposium, Milwaukee, WI.

McCance, J. E., & Tiger, J. H. (2013, October). *Using alternative reinforcers to facilitate delay tolerance following FCT.* Presented at the Mid-American Association for Behavior Analysis Conference, Pewaukee, WI.

Service

University of Wisconsin-Milwaukee, Child Stress and Coping Lab, website manager (2015-Present)

Society of Pediatric Psychology, Diabetes Special Interest Group, Diabetes Education for Mental Health Professionals Project, student member (2015-2016)

Earlham Athletic Committee, student member (2005-2008)

Earlham Psychology Club, member (2005-2008), secretary (2006-2007), and co-convener (2007-2008)

United Way, research campaign volunteer (2007-2008)

Earlham New Student Orientation Committee, member (2007)

Professional Affiliations

American Psychological Association (Student Member, since 2015)

American Psychological Association, Division 54, Society of Pediatric Psychology (Student Member, since 2014)

Wisconsin Association for Behavior Analysis (Student Member, since 2013)

Association for Behavior Analysis International (Student Member, since 2012)

Sigma Xi (Admitted for research and achievement in applied science; Student Member, since 2012)

Phi Beta Kappa (Admitted for academic excellence and moral character; Student Member, since 2008)

Autism Society of America (Professional Member, since 2008)

Psi Chi (Psychology Majors with GPA of 3.5 and higher; Student Member, since 2007)