



## **CPSC Staff Statement<sup>1</sup> on Kalsher & Associates, LLC's, "CPSC Gather Consumer Feedback: Final Report"**

**November 2019**

The report titled, "CPSC Gather Consumer Feedback: Final Report," presents the findings of research conducted by Kalsher & Associates, LLC, under Contract HHSP233201860070A.

The objective of the research was to evaluate a set of 20 graphical safety symbols for comprehension, in an effort to develop a family of graphical symbols that can be used in multiple standards to communicate safety-related information to diverse audiences. The contractor developed 10 new symbols for the project; the remaining 10 symbols already existed. These symbols were selected in collaboration with CPSC staff.

Comprehension was evaluated with a group of 80 non-student participants over the age of 18 years, using the open comprehension test procedures described in ANSI Z535.3, *American National Standard Criteria for Safety Symbols* (2011; R2017). ANSI Z535.3 is the primary U.S. voluntary standard for guiding the design, evaluation, and use of safety symbols to identify and warn against specific hazards, and to provide information to avoid personal injury. In addition, a sub-group of 40 participants took part in one of six focus group sessions, intended to contribute to a fuller understanding of the specific characteristics of the symbols that contribute to, or detract from, the symbols' effectiveness in communicating their respective intended messages.

The test results showed that only 2 of the 20 symbols passed the ANSI Z535.3 comprehension criteria of at least 85 percent correct comprehension, as measured against the contractor's strict (fully correct) criterion, and less than 5 percent critical confusions. The contractor scored a response as a critical confusion if the response indicated the participant understood the symbol in a manner that was opposite to its intended meaning, or if the participant's interpretation could otherwise actively lead to potentially hazardous behavior. Participant feedback indicated that some symbols that did not pass the ANSI Z535.3 comprehension criteria might pass with relatively minor changes. The contractor recommended changes to some symbols that might improve comprehension.

---

<sup>1</sup> This statement was prepared by the CPSC staff, and the attached report was produced by Kalsher & Associates, LLC, for CPSC staff. This statement and associated report have not been reviewed or approved by, and do not necessarily represent the views of, the Commission.

CPSC Gather Consumer Feedback: Final Report

Order Number: HHSP233201860070A

Fall 2019

Contractor: Michael J. Kalsher, Ph.D.

Kalsher & Associates, LLC

1551 Best Road

Rensselaer, NY 12144

Contracting Officer's Representative

Tim Smith

U.S. Consumer Product Safety Commission

5 Research Place

Rockville, MD 20850

## Executive Summary

The goal of this project was to evaluate a set of twenty graphical safety symbols for comprehension. Ten symbols were newly developed for the project. The other ten (existing) symbols are currently in active use. Comprehension was evaluated using the open comprehension test procedures described in ANSI Z535.3 (2011; R2017).

Participants were recruited via a snowball method, posters displayed at public venues, word of mouth, and postings on social media and Craigslist. The final study sample was comprised of 49 female and 31 male participants. The mean age of participants was 44.4 years (*S.D.* = 15.9), ranging in age from 18 to 84 years. The racial profile of the sample was as follows: 69% Caucasian (*n* = 55), 13% African American (*n* = 11), 9% Hispanic/Latino (*n* = 7), 5% Asian (*n* = 4), and 4% gave no response. Given the modest size of the study sample, this breakdown is largely consistent with the 2010 U.S. Census breakdown, which reported the population as 72.4% white, 16.3% Hispanic/Latino, 12.6% African American, and 4.8% Asian. Participant occupations varied widely, falling into seventeen of the Bureau of Labor Statistics' occupation categories. For the most common categories: 19% worked in food preparation or service, 11% were retired, 10% worked in management occupations, and 10% worked in educational instruction. Participant education also varied widely, ranging from some high school completed to doctoral or other professional degrees. Half of the participants (50%) reported having children, 46% reported not having children, and 4% gave no answer to this question.

To evaluate symbol comprehension, 80 participants completed test booklets containing the twenty graphical safety symbols. Four different symbol orderings (booklets) were employed to reduce the potential for carryover effects. Within the booklets, each symbol was sized according to how it might appear on a consumer product or its labeling. In several instances, symbols were presented at the smallest size specified in a consensus standard (e.g., ASTM). Each symbol was accompanied by contextual information (a brief statement and a photograph) intended to communicate the types of products on which the symbol might appear. For each symbol, participants were asked the following three open-ended questions: (1) "What do you think this symbol means?"; (2) "What should you do or not do in response to this symbol?"; and (3) "What could happen if you do not follow the symbol's message?". Additionally, 40 of these individuals participated in a focus group session following their completion of a test booklet. These sessions, six in total, served to facilitate participants' discussion of each symbol in greater detail to gain a better understanding of how people understood the symbols, the positive and negative attributes of each symbol, and specific recommendations for improving each symbol's ability to correctly communicate its intended message.

The test booklets were scored independently by two trained raters using a grading rubric developed by the contractor in cooperation with the CPSC Contracting Officer's Representative (COR). Raters used a binary scoring system (0 = incorrect; 1 = correct) to mark the three open-ended questions. Critical confusions were scored as a "1" if the responses indicated the participant understood the symbol in a manner that was opposite to its intended meaning or if their interpretation could otherwise actively lead to potentially hazardous behavior. Otherwise critical confusion was marked as a "0". After the initial scoring, members of the project team (raters and the contractor) met to review instances of low interrater agreement (lower than 75% agreement) to resolve discrepancies and improve

consistency. For critical confusions, the team reviewed and discussed every disagreement until 100% consensus was reached. Overall, final interrater agreement for each of the three questions for all twenty symbols exceeded 90%, ranging from 91% to 100%.

Additionally, the project team developed a rubric for assigning an overall comprehension score for each participant for each symbol. This score was intended to reflect whether, overall, a participant understood a symbol's intended meaning or not. The scores were assigned using both a lenient (i.e., partially correct) and a strict (i.e., fully correct) criterion. We then used this scoring to determine the number (and percentage) of participants who correctly understood each symbol according to both the strict and lenient criteria, along with the number (and percentage) of participants who did not understand each symbol.

Overall, results of the testing showed that only two of the twenty symbols passed the ANSI Z535.3 comprehension criteria of 85% (or more) correct comprehension, as measured against the strict (fully correct) criterion, with fewer than 5% critical confusions. A summary of the comprehension testing results in terms of the overall comprehension scores and percentage of critical confusions for each of the symbols is presented in Table 4. Participant feedback indicated that some of the symbols that failed to meet the strict criteria would likely pass with relatively minor modifications. However, several symbols clearly did not test well. A brief summary of the reasons for the poorest performers is presented below, with further details in the Results section:

*Symbol 2. Methylene Chloride (or other toxic vapor) (an acute inhalation hazard)* showed both low comprehension and a high percentage of critical confusions. Many participants thought the symbol was referring specifically to drinking a chemical product, rather than inhaling its vapors.

*Symbol 5. Never add soft bedding or padding to (baby's) sleep environment (e.g., a crib) (a suffocation hazard)* showed low comprehension and a high percentage of critical confusions. Many participants did not understand that the symbol was referring to a blanket or soft bedding at all.

*Symbol 7. Install anti-tip restraint (on furniture prone to tip-over; can crush or kill, especially young children)* also showed low comprehension and a high percentage of critical confusions. Some participants focused on the open drawers as the cause of the hazard and many did not notice or understand the depiction of the restraint.

*Symbol 10. Outdoor grills (start with lid open to prevent explosion of built-up gas)* showed low comprehension and a fairly high percentage of critical confusions. The consequence of the symbol (getting burned) was communicated effectively, but the specific hazard (open lid when starting grill) was not clear, especially for those who do not have experience grilling.

*Symbol 18 — Supervision, Drowning (Keep Children Under Supervision; from ASTM F2666 and ASTM F2729)* was generally disliked by focus group participants and it showed relatively low comprehension and a relatively high percentage of critical confusions. Some participants believed the symbol was referring to trespassing or to shallow water and many did not state the implied consequence of drowning.

*Symbol 20: Intended for a Certain Age, Range, Weight (from the EN Report)* showed low comprehension and a high percentage of critical confusions. Many participants thought the symbol was referring to the size of the child, as a height or weight, rather than their age.

## Table of Contents

Background .....	6
Method .....	8
Participants.....	8
Comprehension Testing.....	10
Focus Groups .....	11
Cognitive Interview Scoring Procedure .....	11
Results.....	12
Testing for Carryover Effects .....	12
Testing for Demographic Effects .....	12
Comprehension Testing Overview .....	14
Symbol 1: Furniture Tip-Over .....	16
Symbol 2: Methylene Chloride .....	19
Symbol 3: Magnet Ingestion Hazard.....	22
Symbol 5: Never Add Soft Bedding.....	26
Symbol 6: Place Baby on Back to Sleep .....	29
Symbol 7: Install Anti-Tip Restraint .....	31
Symbol 8: Stay Within Arm’s Reach .....	34
Symbol 9: Stay Within Arm’s Reach .....	36
Symbol 10: Outdoor Grills .....	38
Symbol 11: Laundry Pods .....	41
Symbol 12: Furniture Tip-Over .....	42
Symbol 13: Strangulation Hazard .....	44
Symbol 14: Keep Away From Children .....	46
Symbol 16: Always Use Restraints.....	50
Symbol 17: Age Warning Label.....	52
Symbol 18: Supervision, Drowning.....	55
Symbol 19: Supervision, Drowning.....	57
Symbol 20: Intended for a Certain Age .....	59
Discussion .....	62
Poorest Performing Symbols .....	63

Recommendations for Furniture Tip-Over Symbols..... 63  
Recommendations for Stay Within Arm’s Reach Symbols ..... 63  
Recommendations for Supervision (Drowning) Symbols ..... 63  
Appendices..... 64

## Background

The main purpose of this research was to assess how well a set of safety symbols/pictograms (hereafter graphical symbols) currently in use and a set of newly developed graphical symbols effectively communicate hazards posed by commonly available consumer products. This research followed the open comprehension testing procedures presented in ANSI Z535.3, the American National Standard Criteria for Safety Symbols. ANSI Z535 is the primary U.S. voluntary standard for guiding design of signs, colors, and symbols intended to identify and warn against specific hazards and for other accident prevention purposes. For symbols previously designed and/or validated in accordance with ISO rules of graphical symbols, this research can serve to verify the symbols' understandability in the United States. Staff from the U.S. The Consumer Product Safety Commission (CPSC) provided guidance and support for the project, as needed. The CPSC is authorized under section 5(a) of the CPSA, 15 U.S.C. 2054(a), to conduct research relating to the causes and prevention of injuries or deaths associated with consumer products.

The overall aim of this research is to develop a family of graphical symbols that can be used in multiple standards to communicate safety-related information to diverse audiences. Given the growing diversification of the U.S. population, in concert with the dramatic expansion in global trade, developing understandable graphical symbols is a critical goal. The graphical symbols that were developed and/or tested were selected in collaboration with CPSC staff and chosen based on injury data associated with products and equipment and the severity of the non-obvious hazards that threaten customers.

The contractor and CPSC COR (Timothy Smith) discussed many different graphical symbol options for study, but jointly decided on the final set of symbols presented in Table 1. CPSC staff's top priorities for the to-be-developed hazard symbols were furniture tip-over, methylene chloride, magnet ingestion, keep baby's face free from obstruction (suffocation hazard), never add soft bedding or padding to an infant's sleep environment, and place baby on back to sleep. The top priorities for testing existing symbols were laundry pods, the ASTM's black and white furniture tip-over symbol, strangulation hazard appearing in ANSI/WCMA A100.1, the keep away from children symbol in IEC 60417, two "requires supervision" (a drowning hazard) symbols, always use restraints, and an age warning from EN71-6-94.

The European Commission (2015)<sup>1</sup> had previously tested existing symbol variants for "Never leave your child unattended," "Always use the restraint system," and "A safety message indicating the range of age, weight or height of a child for which the product is intended," among other warning messages for childcare products. The existing symbols from the above messages that tested best in perception, comprehension, and referent association were used in the present research as Symbol 15, Symbol 16, and Symbol 20, respectively.

---

<sup>1</sup> European Commission Consumers, Health, Agriculture and Food Executive Agency (2015). *Design and Validation (in accordance with ISO rules) of graphical symbols conveying certain safety warning messages to be used for childcare articles: Final report.*

During the initial phase of the project, the project team focused primarily on developing and refining the new graphical symbols. This was accomplished through a rapid prototyping approach, based upon the preliminary informal testing procedure outlined in ANSI Z535.3, Appendix B2.1.3, and summarized below:

*B2.1.3 Preliminary Informal Testing. Preliminary comprehension testing may be useful in several ways. It can serve as a verification procedure to determine whether the intended users can specify both the hazard and the measures needed to avoid the hazard. Preliminary informal testing can also be a quick way to identify poor symbols that need to be discarded or modified.*

<b>Table 1.</b> Final set of graphical symbols.
<b>Newly Developed Graphical Symbols</b>
1. Furniture tip-over (can crush or kill, especially young children)
2. Methylene Chloride (or other toxic vapor) (an acute inhalation hazard)
3. Magnet ingestion hazard (swallowed small magnets, typically, but not exclusively ball-shaped, can attract to one another in the intestines, causing internal injuries, as opposed to a choking hazard)
4. Make sure (child’s) restraint fits snugly
5. Never add soft bedding or padding to (baby’s) sleep environment (e.g., a crib) (a suffocation hazard)
6. Place baby on back to sleep (a suffocation hazard)
7. Install anti-tip restraint (on furniture prone to tip-over; can crush or kill, especially young children)
8. Stay within arm’s reach (of baby)
9. Stay within arm’s reach (of baby)
10. Outdoor grills (start with lid open to prevent explosion of built-up gas)
<b>Graphical Symbols Currently in Use</b>
11. Laundry pods (Keep out of reach of children; from ASTM F3159 Standard Safety Specification for Liquid Laundry Packets)
12. Furniture Tip-over (from ASTM F2057017; B&W version)
13. Strangulation hazard (from ANSI/WCMA A100.1 Standard for Corded Window Covering Products)
14. Keep Away From Children (from IEC 60417)
15. Supervision Combination (from the European Normal [EN] Report)
16. Always Use Restraints (from the EN Report)
17. Age Warning Label (from EN71-6-94)
18. Supervision, Drowning ( <i>Keep Children Under Supervision</i> ; from ASTM F2666 and ASTM F2729)
19. Supervision, Drowning ( <i>Keep Children Under Supervision</i> ; from ISO 20712)
20. Intended for a Certain Age, Range, Weight (from the EN Report)

During the initial rapid prototyping phase of the project, individual volunteers and small groups of volunteers were asked to offer their perceptions regarding each symbol’s intended meaning, action(s)



they believe they should take in response to seeing the symbol, and any suggestions for improvement. Each person rated a small number of graphical symbols. These individuals were apprised in advance that there were no direct benefits for their participation other than the knowledge they may contribute to the development of more effective safety symbols for the public good.

Formal testing followed a mixed method approach that included assessing comprehension of the graphical symbols with a group of 80 non-student participants over the age of 18 using the “Open Comprehension Testing” described in ANSI Z535.3 (Appendix B) and conducting focus group sessions with 40 of the participants. The focus group sessions were intended to contribute to a fuller understanding of the specific characteristics of the graphical symbols that contribute, or detract, from their effectiveness in communicating their respective intended messages. Formal testing procedures are described more fully in the sections that follow.

## Method

### Participants

Prospective participants were recruited for this research using a snowball method, posters displayed at public venues (e.g., a local library and YMCA), word of mouth, and through posting on social media and Craigslist. A screener survey with demographic information was used to aid in inviting as diverse a participation pool as possible. As an incentive, participants were offered \$25 for completing a Cognitive Interview Booklet and \$25 for completing the focus group. The method for each of these research components is described below. All of the study’s procedures and materials were reviewed and approved by the Institutional Review Board at Rensselaer Polytechnic Institute.

A total of 82 participants participated in a cognitive interview session (described in greater detail below). The data from two participants was excluded from analyses after it was learned they were students. Two replacement participants were recruited in a subsequent test session, resulting in a final sample of 80 as specified in the contract. Of the 80 participants in the final sample, there were 31 males and 49 females. The mean age of participants was 44.42 years (*S.D.* = 15.94), ranging in age from 18 to 84 years.

A sub-group of 40 participants who had participated in a cognitive interview session took part in one of six focus group sessions that occurred immediately following test booklet sessions between July and September of 2019. The first focus group ( $n = 8$ ) was conducted at the public library in Colonie, New York. The second focus group ( $n = 12$ ) took place in Highwood, Montana. The third focus group ( $n = 3$ ) took place at the public library in Lansingburgh, NY. The fourth focus group ( $n = 2$ ) took place at the Troy public library. The fifth ( $n = 10$ ) and sixth ( $n = 6$ ) focus groups took place at the public library in Colonie, New York.

Participant race was 69% Caucasian ( $n = 55$ ), 13% African American ( $n = 11$ ), 9% Hispanic/Latino ( $n = 7$ ), 5% Asian ( $n = 4$ ), and 4% gave no response. Given the relatively modest size, the ethnic composition of the study sample is consistent with the 2010 U.S. Census<sup>2</sup> ethnicity breakdown, which

---

<sup>2</sup> U.S. Census Bureau, *2010 Redistricting Data (Public Law 94-171) Summary File*.

reported the population as 72.4% white, 16.3% Hispanic/Latino, 12.6% African American, and 4.8% Asian.

The open-ended responses for participant occupations were categorized according to the 2018 Standard Occupational Classification (SOC) system, a federal standard used to classify workers into 23 occupational groups for collecting and analyzing data. Additional categories were used in the present analyses for individuals who reported being retired, a homemaker, or unemployed. Participant occupations varied widely, falling into 17 of the Bureau of Labor Statistics' occupation categories (refer to Table 2). For the most common occupation categories: 18.8% worked in food preparation or service, 11.3% were retired, 10.0% worked in management occupations, and 10.0% worked in educational instruction.

**Table 2.** Reported participant occupations as Standard Occupational Classification (SOC) Categories.

Occupation	Percent	Frequency
Food Preparation and Serving Related Occupations	18.8%	<i>n</i> = 15
<i>Retired</i>	11.3%	<i>n</i> = 9
Education Instruction	10.0%	<i>n</i> = 8
Management Occupations	10.0%	<i>n</i> = 8
Building and Grounds Cleaning and Maintenance Occupations	7.5%	<i>n</i> = 6
Transportation and Material Moving Occupations	7.5%	<i>n</i> = 6
Office and Administrative Support Occupations	6.3%	<i>n</i> = 5
Sales and Related Occupations	5.0%	<i>n</i> = 4
Computer and Mathematical Occupations	3.8%	<i>n</i> = 3
Life, Physical, and Social Science Occupations	3.8%	<i>n</i> = 3
Personal Care and Service Occupations	3.8%	<i>n</i> = 3
<i>Unemployed</i>	3.8%	<i>n</i> = 3
Architecture and Engineering Occupations	2.5%	<i>n</i> = 2
Installation, Maintenance, and Repair Occupations	2.5%	<i>n</i> = 2
Business and Financial Operations Occupations	1.3%	<i>n</i> = 1
Construction and Extraction Occupations	1.3%	<i>n</i> = 1
<i>Homemaker</i>	1.3%	<i>n</i> = 1

Education also varied widely among participants, ranging from completing some high school to completion of doctoral or other professional degrees. Reported education is displayed in Table 3 below.

**Table 3.** Reported participant education level.

Occupation	Percent	Frequency
Some high school	3.0%	<i>n</i> = 2
High school	20.0%	<i>n</i> = 16
Some college	20.0%	<i>n</i> = 16
2-year college degree	13.8%	<i>n</i> = 11
4-year college degree	25.0%	<i>n</i> = 20
Master's degree	13.8%	<i>n</i> = 11
Doctoral degree	3.0%	<i>n</i> = 2
Other professional degree	3.0%	<i>n</i> = 2

Half of participants (50%) reported having children, 46% reported not having children and 4% gave no answer to this question. Overall, the demographic breakdowns reveal that the participant sample for the present research included a range of life experiences. The testing for effects of demographics on symbol comprehension is discussed in the Results section.

### **Comprehension Testing**

Symbol comprehension was assessed in cognitive interview sessions in which small groups of participants (ranging in group size from 2 to 12) completed a Cognitive Interview Booklet (test booklet; see Appendix A). The test booklets were organized and administered according to the open comprehension procedures outlined in ANSI Z535.3 (2011; R2017).

The first page of the test booklet (the title page) provided space for participants to print their name and date of the session. It also included two numbers at the bottom of the page. The first of these was a 7-digit number used to identify the order in which the symbols were presented out of the four different orderings. The only relevant number was in the sixth position (1, 2, 3, or 4), which identified the symbol order. The other eight-digit number identified the project (3041-0136) as specified in the project contract. As noted previously, the four different test booklets (symbol orderings) were created to reduce the likelihood of carryover effects (see Appendix B).

The second page contained a sample (non-tested) symbol that served as a vehicle for instructing participants as to what constituted “good” versus “inadequate” answers (described more fully below). The next twenty pages of the test booklets contained the twenty to-be-tested graphical symbols, each accompanied by contextual information (a brief statement and a photograph) intended to communicate the types of products on which the symbol might appear. Each symbol was sized on the page in accordance with how it would be expected to appear on actual product packaging/labeling. Some symbols were presented at the smallest allowable size specified in a consensus standard (e.g., ASTM). Finally, the last page of the test booklet requested the following demographic information: age, biological sex, highest level of education attained, marital status, whether they had children, race, and current occupation.

After reading and signing an informed consent form, participants received a test booklet along with a detailed set of oral instructions from a member of the research team. The instructions included a review of a sample graphical safety symbol not being tested presented on page two of the booklets (i.e., a hand being crushed by gears). The sample symbol was accompanied by examples of both “good” and “inadequate” answers to the three open-ended questions below, as specified in ANSI Z535.3 (2011; R2017). The purpose of this part of the instruction was to establish a shared mental model among the respondents regarding what constituted a complete answer.

The next twenty pages of the booklet contained the (20) test symbols, their respective supporting contextual information, and space to answer the following three questions: (1) “What do you think this symbol means?”; (2) “What should you do or not do in response to this symbol?”; and (3) “What could happen if you do not follow the symbol’s message?” After completing the test booklets, participants were given the \$25 cash incentive and thanked for their participation. Participants typically completed the test booklets in about one hour.

## Focus Groups

Forty of the 80 participants who completed a test booklet also participated in one of the six focus group sessions. As noted previously, the focus groups were held in the period between July and September 2019 (see Appendix C for more detail). After participants had completed the test booklets and read and signed an informed consent form for the focus group, a member of the research team guided and moderated group discussion of the symbols to gain a better understanding of how the participants understood each symbol, the positive and negative attributes of each one, and specific recommendations for improving each symbol's ability to correctly communicate its intended message. On average, the focus group discussions lasted about an hour in duration. Audio was recorded and transcribed for each of the six focus group sessions.

Participants' suggestions from the focus group discussions for improving each of the twenty symbols are reported in the Results section. Although none of the participants had specific expertise in the areas of warnings and risk communication, their suggestions provided valuable insight into how they understood the symbols.

## Cognitive Interview Scoring Procedure

*Open ended responses and critical confusions.* Two raters scored the test booklets, independently, for each of the three open-ended comprehension questions and identified critical confusions based on these responses. For the three open-ended questions, raters used a binary scoring system in which correct responses were marked as "1" and incorrect responses as "0" according to a scoring rubric developed by the contractor in cooperation with CPSC staff (refer to Appendix D). Critical confusions were scored as a "1" if the open-ended responses to the three questions overall indicated the participant understood the symbol in a manner that was opposite its intended meaning or if their interpretation could otherwise lead to potentially hazardous behavior. Otherwise, critical confusion was marked as a "0."

After the initial scoring, the contractor and the raters met in person to review instances of low inter-rater agreement and discuss discrepancies to improve consistency. For critical confusions, the team reviewed and discussed every scoring discrepancy until 100% consensus was reached. After this process, the final interrater agreement for each of the three open-ended comprehension questions for all twenty symbols exceeded 90%, ranging from 91% to 100%.

*Overall correct interpretations (pass score).* Next, the project team developed a rubric for assigning an overall correct interpretation score (passing score) for each participant's responses to each symbol. This overall comprehension score was derived using both a lenient (i.e., partially correct) and a strict (i.e., fully correct) criterion. Thus, for each symbol, participants' answers were scored as either fully correct, partially correct, or incorrect. This distinction enabled us to tabulate the frequency (and percentage) of participants who correctly understood each symbol according to both the strict and lenient criteria, as well as the frequency (and percentage) of participants who did not.

The criteria for a partially correct or fully correct response were developed individually for each symbol. An overall correct score did not necessarily correspond to the correctness of the individual

open-ended questions, which were scored strictly based on the rubric, but critical confusions were automatically scored as overall incorrect. The specific criteria used to ascribe an incorrect, partially correct, or fully correct score are presented in the Results section for each symbol, respectively.

## Results

Responses from the test booklets were scored for correctness for each of the three open-ended response elements (described previously) based on a scoring rubric, critical confusions based on the responses, and overall correct interpretation (pass score) according to both a “strict” (i.e., fully correct) and “lenient” (i.e., at least partially correct) criterion. Content analysis of the focus group transcripts provided additional detailed information regarding why participants responded the way they did.

### Testing for Carryover Effects

As noted previously, four different symbol orderings were employed (i.e., Test Booklets 1, 2, 3, 4) to counteract the potential for carryover effects. The orderings were arranged such that symbols intended to communicate the same or similar message (e.g., there were three symbols related to furniture tip-over; there were two symbols intended to communicate “stay within arms’ reach of baby”) were separated from each other by at least three non-similar symbols.

A series of one-way ANOVAs (Analyses of Variance) were performed for each of the twenty symbols. Symbol ordering (tracked using the four different booklet numbers) was the between-subjects independent variable and overall pass score was the dependent variable. There was a significant effect of symbol ordering only for Symbol 17 (intended to communicate an age restriction),  $F(3,76) = 3.35, p < .05$ . Post-hoc comparisons using the Sidak procedure (to provide some protection against Type I error) revealed a significant difference in comprehension pass score between test booklet 1 ( $M = 1.24, S.D. = 0.94$ ) and test booklet 2 ( $M = 1.89, S.D. = 0.46$ ) ( $p < .05$ ). All other pairwise comparisons were non-significant ( $p$ 's  $> .05$ ). The ANOVAs performed on the other nineteen symbols were all non-significant ( $p$ 's  $> .05$ ).

Overall, the disproportionately large number of non-significant results indicates that carryover effects were not a significant contributing factor to participants’ comprehension of the test symbols.

### Testing for Demographic Effects

Additional analyses were performed to examine whether demographic variables, including age, biological sex, whether participants had children, education, and race, were significantly related to comprehension. Overall, there were relatively few instances in which the demographic characteristics played a differential role in comprehension for the twenty graphical symbols.

*Age.* Participants’ age was significantly correlated to overall pass score for only two of the symbols; Symbol 3 (magnetic ingestion hazard),  $r = -.35, p < .05$ , and Symbol 12 (ASTM furniture tip-over hazard),  $r = -.25, p < .05$ . These results indicate that overall pass score, at least for these two symbols, was inversely related to age.

*Sex.* A series of independent-samples t-tests, in which biological sex was the grouping variable and overall pass score was the dependent variable, were all non-significant ( $p$ 's > .05), indicating that men and women did not differ in terms of their overall comprehension of the twenty graphical symbols.

*Parenthood.* A series of independent-samples t-tests, in which whether participants had children (yes or no) was the grouping variable and overall comprehension pass score was the dependent variable, revealed significant relationships for two symbols.

The t-test for Symbol 3 (magnet ingestion hazard) showed a significant difference,  $t(72.47) = 2.77, p < .05$ , such that participants who reported having no children ( $M = 1.70, S.D. = 0.62$ ) had significantly higher overall pass scores than participants who reported having children ( $M = 1.25, S.D. = 0.81$ ).

The t-test for Symbol 19 (supervision drowning from ISO 20712) was also significant,  $t(52.05) = 2.92, p < .05$ . Once again, participants who reported having no children ( $M = 1.89, S.D. = 0.32$ ) had significantly higher overall pass scores than participants who reported having children ( $M = 1.50, S.D. = 0.78$ ).

*Education.* The relationship of level of education to overall pass score was also assessed. Because of the small sample sizes in some of the original nine categories (i.e., some high school, high school degree, some college, 2-year college degree, 4-year college degree, master's degree, doctoral, other professional degree, other degree), for the purposes of this analysis we collapsed these into the following three categories: (1) some high school/high school/some college; (2) 2-year/4-year college degree; and (3) advanced degree. One-way ANOVAs were then performed on each of the twenty symbols. Level of education was the between-subjects independent variable and overall comprehension pass score was the dependent variable. There was a significant relationship for only three of the symbols.

For education, the ANOVA for Symbol 1 (newly developed tip-over hazard) was significant  $F(2,77) = 3.22, p < .05$ . Post-hoc comparisons showed a difference only between the least ( $M = 1.06, S.D. = 0.78$ ) and most well-educated ( $M = 1.60, S.D. = 0.63$ ) categories ( $p < .05$ ). No other comparisons were significant,  $p$ 's > .05).

Similarly, the ANOVA for Symbol 7 (Install restraint to avoid tip-over hazard) was significant,  $F(2,77) = 3.28, p < .05$ . Post-hoc comparisons showed a marginally significant difference between the least well-educated category ( $M = 0.88, S.D. = 0.98$ ) and participants with a 2-year or 4-year degree ( $M = 1.42, S.D. = 0.85$ ),  $p = .06$ . No other comparisons were significant ( $p$ 's > .05).

The ANOVA for Symbol 8 (stay within arm's reach of baby) was significant,  $F(2,77) = 4.97, p < .05$ . Post-hoc comparisons showed a significant difference between the least well-educated category ( $M = 1.32, S.D. = 0.77$ ) and the other two categories. Specifically, the groups with either a 2-year or 4-year degree ( $M = 1.74, S.D. = 0.58$ ) or an advanced degree ( $M = 1.87, S.D. = 0.52$ ). The difference between the latter two categories was not significant,  $p > .05$ .

*Marital status.* A similar process was used to reduce the marital status categories from four (single, married, legally separated, divorced) to three categories: (1) single; (2) married; (3) divorced or separated. There were no significant differences found for this variable, all  $p$ 's > .05.

*Race.* Finally, we examined whether race was significantly related to overall comprehension pass score. Although the demographic section of the test booklets offered eight racial options (Asian, Black/African, Caucasian, Hispanic/Latino, Native American, Pacific Islander, Mixed Race, Prefer not to answer), all of the 80 study participants fit into five categories: Asian, Black/African, Caucasian, Hispanic/Latino and Prefer not to answer. One-way ANOVAs were then performed on each of the twenty symbols where racial category was the independent variable and overall comprehension pass score was the dependent variable. There was a significant relationship for four of the symbols.

The ANOVA for Symbol 5 (Soft bedding suffocation hazard) was significant,  $F(2,77) = 3.26$ ,  $p < .05$ . Post-hoc comparisons showed a marginally significant difference between African American ( $M = 0.64$ ,  $S.D. = 0.92$ ) and Caucasian ( $M = 1.45$ ,  $S.D. = 0.84$ ) participants,  $p = .06$ .

The ANOVA for Symbol 10 (Gas grill burn hazard) was significant,  $F(4,75) = 5.18$ ,  $p < .05$ . Post-hoc comparisons showed significant differences between Asian ( $M = 0.0$ ,  $S.D. = 0.0$ ) and Caucasian participants ( $M = 1.44$ ,  $S.D. = 0.83$ ) and between Caucasian and African American participants ( $M = 0.64$ ,  $S.D. = 0.81$ ). No other comparisons were significant,  $p$ 's > .05.

The ANOVA for Symbol 17 (Age restriction EN71-6-94) was significant,  $F(4,75) = 4.42$ ,  $p < .05$ . Post-hoc comparisons showed a significant difference only between Hispanic-Latino ( $M = 0.86$ ,  $S.D. = 1.07$ ) and Caucasian participants ( $M = 1.82$ ,  $S.D. = 0.55$ ). No other comparisons were significant,  $p$ 's > .05.

The ANOVA for Symbol 20 (Intended for a Certain Age, Range, Weight from the EN Report) was significant,  $F(4,75) = 3.0$ ,  $p < .05$ . Post-hoc comparisons showed a significant difference between African American ( $M = 0.55$ ,  $S.D. = 0.93$ ) and Caucasian ( $M = 1.45$ ,  $S.D. = 0.79$ ) participants. No other comparisons were significant,  $p$ 's > .05.


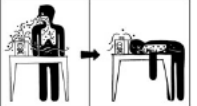







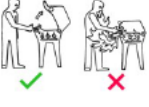










### **Comprehension Testing Overview**

As noted previously, the project team developed a rubric for assigning an overall correct interpretation score for each participant's responses to each symbol. This score was derived using both a lenient (i.e., partially correct) and a strict (i.e., fully correct) criterion. So for each symbol, participants' answers were scored as either fully correct, partially correct, or incorrect. This distinction enabled us to tabulate the frequency (and percentage) of participants who correctly understood each symbol according to both the strict and lenient criteria, as well as the frequency (and percentage) of participants who did not. We also determined the percentage of incorrect responses that constituted critical confusions. These percentages are displayed in Table 4 below.

The criteria for "passing," as defined by ANSI Z535.3 (2016) is at least 85% correct interpretations, with fewer than 5% critical confusions. We used the strict criteria to determine the passing score. More detailed information concerning analyses of the test booklets and focus groups is provided separately for each symbol in the sections that follow.

There were several instances in which respondents failed to write a response to specific questions or wrote “I don’t know.” Both were treated as incorrect responses, but not as critical confusions. Similarly, there were instances in which the writing was unintelligible, and these were also scored as incorrect. Finally, responses that stated something similar to “follow instructions,” “read the manual,” or “follow this symbol” were also marked as incorrect, but not as critical confusions.


**Table 4.** Overall comprehension testing results organized by correct responses according to both the strict (fully correct) and lenient (at least partially correct) criteria (% Correct) and critical confusions (% Critical C’s) as a percentage of total responses for each of the twenty graphical symbols.

Symbol					
% Correct					
Strict	56.3	70.0	62.5	88.8	56.3
Lenient	80.0	72.5	85.0	92.5	66.3
% Critical Cs	2.5	21.3	1.3	1.3	23.8
Symbol					
% Correct					
Strict	87.5	55.0	70.0	72.5	56.3
Lenient	93.8	63.8	88.8	91.3	68.8
% Critical Cs	1.3	6.3	0.0	0.0	5.0
Symbol					
% Correct					
Strict	80.0	63.8	78.8	77.5	55.0
Lenient	93.8	87.5	93.8	80.0	90.0
% Critical Cs	0.0	0.0	1.3	0.0	2.5
Symbol					
% Correct					
Strict	72.5	81.3	68.8	78.8	58.8
Lenient	93.8	83.8	83.8	91.3	72.5
% Critical Cs	1.3	6.3	5.0	3.8	18.8



## Symbol 1: Furniture Tip-Over

### Cognitive Interview Booklet Elements

	<b>Percent Correct</b> (# correct)	<b>Grading Rubric</b>
What do you think this symbol means?	68.0% (55)	If a child climbs on this piece of furniture, the furniture may tip over.
What should you do or not do in response to this symbol?	62.5% (50)	Do not allow children to climb on the furniture.
What could happen if you do not follow the symbol's message?	80.0% (64)	The furniture could fall/tip over onto the child.

### Overall Comprehension

	<b>Count (n)</b>	<b>Percent</b>
<b>Overall Correct</b>	64	80.0%
Strict Criteria	45	56.3%
Lenient Criteria	64	80.0%
<b>Overall Incorrect</b>	16	20.0%
Critical Confusions	2	
As a % of incorrect responses		12.5%
As a % of total responses		2.5%
<b>Total</b>	80	100%
<i>Fully correct response:</i>		
- Must mention a child/person climbing dresser (or climbing/standing on dresser drawers) and the furniture tipping/falling		
<i>Partially correct response (only mentions one or more of the following):</i>		
- Furniture tipping/falling because of open drawers		
- Action is to supervise children (i.e., not actively preventing them from climbing)		

<b>Critical Confusion Statement</b>	<b>Frequency</b>
The furniture is unstable; the weight needs to be redistributed	<i>n</i> = 1
The furniture is too tall to see over	<i>n</i> = 1

For Symbol 1, two responses were marked as critical confusions because these incorrect interpretations could result in people, and in particular young children, climbing on the furniture and potentially getting injured. Other incorrect responses that suggested “keeping furniture away from children,” or similar interpretations, still conveyed that the respondent fundamentally would not be putting themselves or others in danger from their misunderstanding.

*Focus Groups.* Overall, participants expressed a number of concerns with this symbol, as illustrated by the sample “general” quotes below. Participants tended to correctly understand that the image depicts a dresser that is falling and that a person or child is climbing it. However, they were less clear about what to do in response to this symbol. This outcome may have been due, at least in part, to the fact they saw three symbols (Symbols 1, 7, and 12) that involved falling furniture.

*“That one was the one that was the most confusing to me, like is it you gotta, like, keep your drawers like shut? Or do you just need to make sure it’s secure against the wall? But I mean it I figured both of those things, but I don’t know.” — Participant in Group 5*

*“The first one I saw was this one I think — you either secure the dresser or provide supervision. But then when I saw the one with secured dresser where it had the bracket holding it up. I’m thinking, are you supposed to not secure them either? Maybe that’s not smart, maybe you should just be watching your children, I mean, I don’t know. Obviously, the problem is you don’t want a child to be crushed by it, but I’m not quite sure what they were recommending.” — Participant in Group 5*

Some groups (1 and 6) took the symbol to mean that one should use caution when moving “top-heavy” furniture. Others interpreted the symbol as a caution to lock or secure drawers, explaining that the symbol looks like it is communicating that one should not leave drawers open. Group 1 also talked about how the lines of movement depicted in this symbol were misconstrued as broken restraint straps.

<b>Suggestion</b>	<b>From</b>	<b>Quotes</b>
Use the prohibition symbol with this symbol	Groups 1, 4, & 5	<p>“Probably put one of those red signs on it. To like make people know that this situation is serious – it could possibly break the kid’s leg or whatever if it fell on top of them... depending on how small they is.” — <i>Participant in Group 4</i></p> <p>“I think the other one that had the circle with a slash through it, I thought that was better.” — <i>Participant in Group 5</i></p>
Use an arrow to convey the motion of falling	Group 1	<p><b>Mod: So, you’re saying you don’t need those two [motion] lines behind [the dresser]?</b></p> <p>“No, I would put a red arrow. Red is definitely going to stand out and you also have with some other things that pointing out something that’s negative. Red will stand out further.”</p> <p>— <i>Discussion in Group 1</i></p>
Depict the person as more clearly a child in danger	Group 6	<p>“It looks like he’s having a blast.”</p> <p>“It’s possibly not a child.”</p> <p>“He’s like, ‘woo hoo!’”</p> <p>“How do you know it’s a child?” — <i>Discussion in Group 6</i></p>


### *Symbol 1 Summary*

This symbol overall does not pass comprehension criteria. There were only two critical confusions, but correct interpretations did not exceed 85% by either strict (56.3%) and lenient (80%) criteria. The “movement” lines in this symbol were sometimes misconstrued as showing a broken restraint.

Comprehension of this symbol would likely be greatly improved by adding a prohibition symbol and clarifying how installation of an anti-tip restraint can further safeguard against tip-over, essentially combining the three similar furniture tip-over symbols that were tested. Proposed design changes to the furniture tipping symbols will be discussed in more detail in the overall Discussion section.

## Symbol 2: Methylene Chloride

### Cognitive Interview Booklet Elements

	<b>Percent Correct</b> (# correct)	<b>Grading Rubric</b>
What do you think this symbol means?	70.0% (56)	If the fumes from this chemical are inhaled, it may result in unconsciousness, serious injury, or death.
What should you do or not do in response to this symbol?	70.0% (56)	Do not inhale fumes.
What could happen if you do not follow the symbol's message?	95.0% (76)	Loss of consciousness, serious injury, death

### Overall Comprehension

	<b>Count (n)</b>	<b>Percent</b>
<b>Overall Correct</b>	58	72.5%
Strict Criteria	56	70.0%
Lenient Criteria	58	72.5%
<b>Overall Incorrect</b>	22	27.5%
Critical Confusions	17	
As a % of incorrect responses		77.3%
As a % of total responses		21.3%
<b>Total</b>	80	100%
<i>Fully correct response:</i>		
- Must mention avoiding breathing/inhaling a chemical that could cause loss of consciousness or death		
<i>Partially correct response (only mentions one or more of the following):</i>		
- You could get hurt (i.e., without mentioning how)		
- Do not smell		

<b>Critical Confusion Statement</b>	<b>Frequency</b>
Refers to drinking, ingesting, or overdosing	<i>n</i> = 17

For Symbol 2, responses marked as critical confusions were all related to misinterpreting the symbol as communicating the dangers of ingesting (swallowing) a chemical rather than inhaling it. These were identified as critical confusions because following this misinterpretation could result in avoiding drinking the chemical while still inhaling its emitted vapors.

*Focus Groups.* As observed in the booklet response data, many participants said that they thought the symbol meant “no drinking,” without noticing or understanding the vapors constitute an inhalation hazard. Some participants stated that they thought the vapor did not look like vapor, so they did not understand that the symbol was communicating the dangers of inhalation. Group 1 talked about how they understood the meaning of the symbol specifically as “use in a ventilated area.”

The focus groups indicated that they liked the multiple panels with the second panel showing the consequence of the person impacted by the hazard. The person in the second panel was clearly perceived to be seriously injured: Group 1 and Group 2 disagreed among themselves about whether the person was sick or dead. Some participants did not notice the Xs on the eyes.

Group 5 and Group 6 indicated that they liked the multiple panels and the skull and crossbones. However, a participant in Group 6 also said they did not see or notice the skull and crossbones.

<b>Suggestion</b>	<b>From</b>	<b>Quotes</b>
Clearer depiction of vapor	Groups 1, 2, 3, 4, & 6	<p>“What was confusing about me for the picture were the dots. I feel like you wouldn’t see dots, and I feel like the fumes would be more wavy lines. [...] And then there is also no direction. Like I feel like arrows or what direction of the fumes.” — <i>Participant in Group 2</i></p> <p>“If the lines were drawn as more of a cloud, I think the symbol would better represent fumes.” — <i>Participant in Group 3</i></p> <p>“When I looked at it, I thought it was vapor because you had the little dots going into what are lungs, but then I thought it was liquid because you had lines including lines that go sort of, not sort of through the mouth to the stomach, but horizontally into the stomach.” — <i>Participant in Group 6</i></p> <p>“I think that's what's confusing is the lines — maybe like little puffs of cloud [would be better].” — <i>Participant in Group 6</i></p>
Make lungs or nose more prominent	Groups 1, 3, 4, 5, & 6	<p><b>Mod: How do you think we could portray vapor then?</b>            “A nose.”  <b>Mod: A nose?</b>            “Yeah, a nose and then the lines going up the nose.”            “I mean it’s going into its neck.”            — <i>Discussion in Group 1</i></p> <p>“I don’t even see a nose. Make the nose more pronounced. Show the fumes going into the nose rather than the mouth.” — <i>Participant in Group 3</i></p> <p><b>Mod: So, you would want more of a close-up of the nose?</b>            “Yes. Yeah with the little lines up, like the smoke and everything. With a hazardous symbol.”  <b>Mod: Do you think that with that would, in your mind, still need to have the second picture? Or would just have that image of the nose with the product?</b>            “I would want the second picture too.”  <b>Mod: Okay, so you would just change the first picture?</b>            “Yeah, I would take all the designs out of it. At first, I didn’t know what it was. I thought it was a plan or water.”  <b>Mod: So, the lines and the dots aren’t clear...?</b></p>


		<p>“Well, they kind of made it clearer to me that the chemicals are strong smelling. That the aroma, as soon as you untop it, the aroma can go into your lungs.”</p> <p>“Well it kind of made it awkward with the lines. I thought he was smoking it.”</p> <p><b>Mod: So, would you also want to make the lungs more prominent too?</b></p> <p>“Yeah, so that at least they could see that it’s for the lungs, not the stomach.”</p> <p>— <i>Discussion in Group 4</i></p> <p>“Maybe like a pair of lungs. I’ve seen the pair of lungs over the shoulder [as a separate image] sometimes. They’re lung-shaped in retrospect, but I feel kind of silly now, but yeah.” — <i>Participant in Group 5</i></p> <p>“Now I’m realizing those are lungs. That’s not a stomach.” — <i>Participant in Group 6</i></p>
Information about what to do in response to vapor	Groups 3 & 5	<p>“Maybe instead of the current second panel you could have the person wearing a ventilation mask. Kind of to drive the point home that the fumes are toxic.” — <i>Participant in Group 3</i></p> <p>“It wasn’t clear what to do about it. Like, I said [in the booklet] something about ventilating.” — <i>Participant in Group 5</i></p> <p>“It doesn’t really tell you what to do. Not inhale it, but how much time do you inhale it, do you limit the size of the room, do you ventilate the room? Would a mask help? It doesn’t really tell you what to do to prevent breathing it in. Or just don’t use those chemicals, I guess.” — <i>Participant in Group 5</i></p>
Use color	Group 1	<p>“What about color? It’s so plain black and white. What about the green and the yellow, would help in this situation opposed to show a hazard as red.”</p> <p>“Make the gas green.”</p> <p>[Multiple people agreeing.]</p> <p>“Red eyes, crosses. Make the eyes red so they stand out.”</p> <p>— <i>Discussion in Group 1</i></p>

### Symbol 2 Summary

Symbol 2 did not pass comprehension criteria. Strict (70%) and lenient (72.5%) scorings of interpretations were below 85%. There were many critical confusions ( $n = 17$ ) that were all similarly misinterpreting the symbol’s meaning as a warning against the hazards of ingesting/swallowing chemicals by mouth rather than inhaling vapors. This symbol’s comprehension would likely improve with design changes to clarify the presence of dangerous vapors and to clarify the action of inhaling.

### Symbol 3: Magnet Ingestion Hazard

#### Cognitive Interview Booklet Elements

	<b>Percent Correct</b> (# correct)	<b>Grading Rubric</b>
What do you think this symbol means?	87.5% (70)	Ingesting magnets can cause them to attract within the digestive system and compress those tissues.
What should you do or not do in response to this symbol?	77.5% (62)	Do not swallow the magnets.
What could happen if you do not follow the symbol's message?	82.5% (66)	Serious injury (predominantly in the digestive track/intestines)

#### Overall Comprehension

	<b>Count (n)</b>	<b>Percent</b>
<b>Overall Correct</b>	68	85.0%
Strict Criteria	50	62.5%
Lenient Criteria	68	85.0%
<b>Overall Incorrect</b>	12	15.0%
Critical Confusions	1	
As a % of incorrect responses		8.3%
As a % of total responses		1.3%
<b>Total</b>	80	100%
<i>Fully correct response:</i>		
- Must mention how swallowing magnets can result in them attracting inside the body and causing injury		
<i>Partially correct response (only mentions one or more of the following):</i>		
- Swallowing or choking but not the magnet hazard		

<b>Critical Confusion Statement</b>	<b>Frequency</b>
Do ingest the magnets	$n = 1$

There was one critical confusion for Symbol 3, in which a respondent stated that it appeared as if the image was telling you to ingest magnets, which is opposite the intended meaning.

*Focus Groups.* Overall, the focus group participants agreed that this was a clear symbol. Nearly everyone understood that the symbol indicated that one should not eat magnets. However, the specifics of the injury regarding the magnets attracting one another in the intestines was less clear. Group 1

discussed how it seemed that the symbol communicated that eating one magnet would be safe, but two would be dangerous.


<b>Suggestion</b>	<b>From</b>	<b>Quotes</b>
Change how the person is shown eating the magnets	Groups 2, 3, & 4	<p>“If you just look at his hand and his mouth, it looks like it could be candy.” – <i>Participant in Group 2</i></p> <p>“I did not realize they were magnets. No, I just thought it was any small object.” – <i>Participant in Group 2</i></p> <p>“Maybe make the kid younger even?”</p> <p>“Yeah, I would agree. The symbol looked like an adult to me.” – <i>Discussion in Group 3</i></p> <p>“At first, I thought he was smoking a cigarette. [...] I guess I would make it clearer to make sure to limit the chances of swallowing. They should make sure that the directions are clear in that aspect.” – <i>Participant in Group 4</i></p>
Use the prohibition symbol	Groups 1, 2, & 4	<p>“Yeah but it doesn’t have a line through it, it looks like it’s okay to eat it.” – <i>Participant in Group 1</i></p> <p>“Put a big ‘X’ over the picture.” – <i>Participant in Group 4</i></p>
Make adjustments to the look of the intestines	Groups 2 & 6	<p>“When I first saw it like without looking at the close-up picture, I thought it was going to be a choking hazard.” – <i>Participant in Group 2</i></p> <p>“I like the top one better. [...] I like the panel above [in symbol 2] better where it's full size on both. [...] If someone's not familiar with, um, you know, the workings of the stomach, they might not know what that is.” – <i>Participant in Group 6</i></p>
Use the horseshoe magnet symbol more than once	Group 2	<p>“I was going to say use the universal symbol of the magnet, which is the horseshoe, add that with the magnets.”</p> <p>“Yeah.”</p> <p>“Yeah, I didn’t know they were magnets.”</p> <p>“Yeah, I didn’t realize there were horseshoe symbols in there...”</p> <p>“Because they’re so small in there.”</p> <p>“I thought they were just red spheres with a little white thing in there.”</p> <p>“I’d put the horseshoes with these magnets.” – <i>Discussion in Group 2</i></p>

### *Symbol 3 Summary*

This symbol did not pass comprehension criteria (85% correct comprehension) when responses were scored according to the strict, fully correct criteria (62.5%). Fully correct scores required that respondents indicate the specific hazard of magnets attracting within the digestive system when swallowed. This symbol’s comprehension could likely be improved by adding a prohibition sign to the act of swallowing the magnets and further visually emphasizing the magnets attracting one another inside the digestive tract.



Symbol 4: Make Sure Restraint Fits Snugly  
Cognitive Interview Booklet Elements

<b>Table 8a.</b> Percentage and frequency of correct responses to each element according to the grading rubric.		
	<b>Percent Correct</b> (# correct)	<b>Grading Rubric</b>
What do you think this symbol means?	88.8% (71)	When using this child restraint device, the straps should be tight and secure, not loose.
What should you do or not do in response to this symbol?	91.3% (73)	Tighten the straps.
What could happen if you do not follow the symbol's message?	93.8% (75)	Child may be injured (Implied but not essential).

*Overall Comprehension*

<b>Table 8b.</b> Count and percent of correct and incorrect responses for Symbol 4.		
	<b>Count (n)</b>	<b>Percent</b>
<b>Overall Correct</b>	74	92.5%
Strict Criteria	71	88.8%
Lenient Criteria	74	92.5%
<b>Overall Incorrect</b>	6	7.5%
Critical Confusions	1	
As a % of incorrect responses		16.7%
As a % of total responses		1.3%
<b>Total</b>	80	100%
<i>Fully correct response:</i>		
- Must mention tightening straps so child does not fall		
<i>Partially correct response (only mentions one or more of the following):</i>		
- Buckle child		

<b>Table 8c.</b> Critical Confusion Statements and frequency of occurrence for Symbol 4.	
<b>Critical Confusion Statement</b>	<b>Frequency</b>
Do not leave child unattended	<i>n</i> = 1

For Symbol 4, one response was identified as a critical confusion that indicated not to leave a child unattended. The respondent made no mention of securing the child or tightening the straps. A person who followed this misinterpretation could still neglect to safely buckle their child while attending to them.

*Focus Groups.* Participants understood and liked this image overall. They said that they generally understood that adult hands were tightening the safety belt to secure the child. A few participants gave small suggestions about improving the image.


Table 8d. Focus group suggestions for Symbol 4.		
Suggestion	From	Quotes
Make the direction of the seatbelt clear	Group 2	“Well, there is one thing I think in the correct version maybe it could be a little bit better. How the black belt has a point to it, but it could almost look like an arrow if you just add a little bit, that way you could tell what direction it was going.” —Participant in Group 2
Give the child clothing	Group 4	<b>Mod: Did you like the design of the baby?</b> “No. The baby needs a shirt on or something. Why’s the baby naked?” — Discussion in Group 4
Adjust the look of the hands	Group 6	<b>Mod: Anything else that would make this better? Or a different way of showing this?</b> “The extra hands I think throws people off. “ <b>Mod: Extra hands is weird, okay.</b> “Yeah, it’s kinda weird.” “It does look like there’s two people. Or someone is very bendy.” “They’re both right hands.” — Discussion in Group 6

#### Symbol 4 Summary

Symbol 4 performed well for comprehension. This symbol passed comprehension criteria with just one critical confusion and more than 85% correct comprehension by both strict (88.8%) and lenient (92.5%) scoring criteria. Participants’ suggestions for improvements to Symbol 4 were minor and cosmetic.

**Symbol 5: Never Add Soft Bedding**

*Cognitive Interview Booklet Elements*

<b>Table 9a.</b> Percentage and frequency of correct responses to each element according to the grading rubric.		
	<b>Percent Correct</b> (# correct)	<b>Grading Rubric</b>
What do you think this symbol means?	63.8% (51)	Do not put soft materials, such as blankets or pillows, in a baby's sleep environment. They may suffocate the baby.
What should you do or not do in response to this symbol?	62.5% (50)	Do not put blankets, pillows or other soft materials into a baby's sleep environment.
What could happen if you do not follow the symbol's message?	76.3% (61)	Child may suffocate and die.

*Overall Comprehension*

<b>Table 9b.</b> Count and percent of correct and incorrect responses for Symbol 5.		
	<b>Count (n)</b>	<b>Percent</b>
<b>Overall Correct</b>	53	66.3%
Strict Criteria	45	56.3%
Lenient Criteria	53	66.3%
<b>Overall Incorrect</b>	27	33.8%
Critical Confusions	19	
As a % of incorrect responses		70.4%
As a % of total responses		23.8%
<b>Total</b>	80	100%
<i>Fully correct response:</i>		
- Must mention that blankets or pillows could cause the baby to suffocate		
<i>Partially correct response (only mentions one or more of the following):</i>		
- The baby/child could die (without the specific cause)		

<b>Table 9c.</b> Critical Confusion Statements and frequency of occurrence for Symbol 5.	
<b>Critical Confusion Statement</b>	<b>Frequency</b>
Don't let child sleep on stomach/face down	<i>n</i> = 7
Do not remove items from bed	<i>n</i> = 4
Don't place loose clothing or blanket on railing	<i>n</i> = 2
Don't let blanket cover face	<i>n</i> = 2
Keep baby away from rails	<i>n</i> = 1
Child can climb on objects in bed and fall out	<i>n</i> = 1
Lower bars before lifting child from crib	<i>n</i> = 1

Don't use a broken crib	<i>n</i> = 1
Don't put crib near curtain	<i>n</i> = 1
Baby will fall	<i>n</i> = 1
Don't let child sleep on back	<i>n</i> = 1

There were several critical confusions for Symbol 5 that stemmed from different misinterpretations. All of these misinterpretations could indirectly lead to behaviors that could put a child at risk of injury. Respondents who misunderstand the symbol in these ways may still put loose blankets, or similar materials, in the baby's sleeping area and potentially cause the baby to suffocate.

*Focus Groups.* This symbol was unclear to many participants. The connection between the first and second image was not clear — the blanket in the first image was not always clearly understood to be related to the baby in the second image. Two groups (2 and 6) also discussed how some participants thought that the arms depicted in the first image were depicting a child's legs climbing in the crib. Some positive feedback was that the color of the child's face tended to convey that the child had suffocated and that this consequence was clearer than the actual hazard.

<b>Suggestion</b>	<b>From</b>	<b>Quotes</b>
Show a correct and incorrect comparison with a baby with a blanket and no blanket	Groups 1, 3, & 5	<p>"What if you have an empty crib with a green check mark and a cluttered crib with a red "X"? Similar to the last one, I guess. And a happy baby and a sad baby."  " Yeah."  "Because I was confused what was coming out of there."  "Or right over here a picture of a pillow or a blanket with that same thing next to it. Because I couldn't figure out what was in there. It looks like she was in there fixing it. Like don't do it like that, don't pile it in the corner. So if it was outside the crib, with the pillow and the blanket and then move the prohibition symbol over it so you know..."  " No pillow, no blanket."  — <i>Discussion in Group 1</i></p> <p>"I understood that that is a blanket. It just seemed like an odd picture. You wouldn't just put a blob of a blanket in the corner. You would put a blanket on a baby if it was old enough." — <i>Participant in Group 3</i></p> <p>"I would do the correct and incorrect, [it] would be clearer. Show the baby without a blanket." — <i>Participant in Group 5</i></p>
Make the blanket clearer	Groups 3 & 6	<p>"Maybe if the baby were actually in the crib and the mom was putting the blanket with the baby because that just seems weird that you would put a blob of a blanket in the corner." — <i>Participant in Group 3</i></p> <p>"The blanket is on the forehead. It's not over the mouth." — <i>Participant in Group 6</i></p>
Make the position of the arms more natural	Groups 1 & 4	<p>"Well the artist could do better with the arms because it looks like there are two people with right arms going in the crib with two elbows." — <i>Participant in Group 1</i></p> <p>"I would just make the arms littler and the blanket bigger."</p>

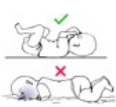
		<p><b>Mod: Oh, so make the blanket bigger and the arms littler? Okay. [...]</b>  “Okay. And yeah the arms look like feet now that you mention it.”  “Then I was like you just see like two little squiggles and then some elbows.”  “Because they’re like made long and twisty. I’ve never seen someone’s arms like that.”  — <i>Discussion in Group 4</i></p>
--	--	--

*Symbol 5 Summary*

Symbol 5 performed poorly and did not pass comprehension criteria. There were 19 critical confusions that represented 11 different misinterpretations. Just over half of participants (56.3%) interpreted Symbol 5 correctly according to strict criteria. This symbol was overall too complex with too many elements. A symbol design that may yield better comprehension could show a two-panel comparison between correct and incorrect bedding for the baby in a crib.

## Symbol 6: Place Baby on Back to Sleep

### Cognitive Interview Booklet Elements

	Percent Correct (# correct)	Grading Rubric
What do you think this symbol means?	93.7% (75)	Lay baby on her/his back, not her/his stomach to sleep to avoid suffocation.
What should you do or not do in response to this symbol?	93.7% (75)	Place baby on his/her/their back in a sleeping environment.
What could happen if you do not follow the symbol's message?	93.7% (75)	Child may suffocate and die.

### Overall Comprehension

	Count (n)	Percent
<b>Overall Correct</b>	75	93.8%
Strict Criteria	70	87.5%
Lenient Criteria	75	93.8%
<b>Overall Incorrect</b>	5	6.3%
Critical Confusions	1	
As a % of incorrect responses		20.0%
As a % of total responses		1.3%
<b>Total</b>	80	100%
<i>Fully correct response:</i>		
- Must mention that the baby needs to sleep on their back to avoid suffocation		
<i>Partially correct response (only mentions one or more of the following):</i>		
- The baby/child could die (without the specific cause)		

Critical Confusion Statement	Frequency
No hanging or standing on crib	<i>n</i> = 1

The single critical confusion for Symbol 8, “no hanging or standing on crib,” could result in potentially hazardous behavior because the person did not fundamentally understand that the baby should be placed on its back.

*Focus Groups.* This symbol was overall clearly understood by participants with little follow-up discussion. Participants stated that the green checkmark and red X made it easy to understand the intended meaning. However, some participants talked about how this image conveys two different

warnings: that the child should be on its back and that loose blankets could cause suffocation. This overcommunication caused some incorrect responses, but not critical confusions.


<b>Table 10d.</b> Focus group suggestions for Symbol 6.		
<b>Suggestion</b>	<b>From</b>	<b>Quotes</b>
Clarify the soft bedding	Groups 1, 3	<p>“With that too though, there’s a line that represents a hard surface, but when he’s faced down the line looks lumpy. In this one there’s kind of like a double message: put your baby on his back on a hard surface and don’t put your baby faced down on a soft service. So could you put your baby faced down on a hard service?” — <i>Participant in Group 1</i></p> <p><b>Mod: What did you guys think about symbol number six?</b>            “Not to put the baby on their stomach to sleep.”            “And also, to keep the crib without anything underneath the baby.”            “Oh, I didn’t get that second point from the symbol. “            “I just thought because of the change in texture underneath the baby.”            “Yeah, I didn’t catch that. I just said don’t put the baby on their stomach.”            “Maybe make the blanket a different color? To show the difference between the mattress and the blanket underneath the child.”</p> <p><b>Mod: Do you think that the second panel is better suited for this symbol?</b>            “Well I gotta say that I didn’t really recognize that there was a different texture. And normally we would put a fitted sheet on the mattress but not extra blankets.            “Maybe add more texture to the blanket – make it a quilt or a blanket.”            — <i>Discussion in Group 3</i></p>

### *Symbol 6 Summary*

This symbol performed well, with passing levels of comprehension (greater than 85%) according to both strict (87.85%) and lenient (93.8%) scoring criteria and only one critical confusion. The comparison of a baby on their back with a green check mark and the baby on their stomach with a red X helped to correctly communicate the hazard.

## Symbol 7: Install Anti-Tip Restraint

### Cognitive Interview Booklet Elements

<b>Table 11a.</b> Percentage and frequency of correct responses to each element according to the grading rubric.		
	<b>Percent Correct</b> (# correct)	<b>Grading Rubric</b>
What do you think this symbol means?	56.3% (45)	Secure wall restraint between the wall and piece of furniture to prevent tip over.
What should you do or not do in response to this symbol?	62.5% (50)	Install the wall restraint. (Implied but not essential: Make sure the restraint is secure.)
What could happen if you do not follow the symbol's message?	72.5% (58)	The furniture could fall/tip over onto the child.

### Overall Comprehension

<b>Table 11b.</b> Count and percent of correct and incorrect responses for Symbol 7.		
	<b>Count (n)</b>	<b>Percent</b>
<b>Overall Correct</b>	51	63.8%
Strict Criteria	44	55.0%
Lenient Criteria	51	63.8%
<b>Overall Incorrect</b>	29	36.3%
Critical Confusions	5	
As a % of incorrect responses		17.2%
As a % of total responses		6.3%
<b>Total</b>	80	100%
<i>Fully correct response:</i>		
- Must mention the that the restraint secured on the wall helps prevent furniture falling and the child/person from getting hurt		
<i>Partially correct response (only mentions one or more of the following):</i>		
- Don't trust the bracket		

<b>Table 11c.</b> Critical Confusion Statements and frequency of occurrence for Symbol 7.	
<b>Critical Confusion Statement</b>	<b>Frequency</b>
Don't wedge a piece of furniture at the top	<i>n</i> = 1

There was one critical confusion for Symbol 7, which made no mention of the important elements of the symbol's intended meaning. This respondent interpreted the symbol to mean "don't wedge a piece of furniture at the top," which could result in potentially hazardous behavior by not understanding the dangers of climbing furniture or the importance of securing furniture. Other incorrect



responses were centered on preventing children from climbing furniture without mention of the bracket, which were not critical confusions.

*Focus Groups.* Some participants identified this symbol correctly, and others thought it was similar to the other furniture symbols and that it communicated to keep children from climbing furniture. The groups discussed their confusion with how the restraint was depicted. Many participants talked about not recognizing the bracket or restraint in the symbol. Some example quotes about this confusion are below.

*“That one kind of tripped me up at first because I thought that the object could break the wall. Then I looked again and saw the restraint. So, I had to look twice but I got it eventually. But I looked at it quickly and thought that there was an explosion because the kid pulled something out of the wall.” — Participant in Group 3*

*“I thought this was just like, like the motion of it falling. I didn’t realize that was supposed to be a bracket.” — Participant in Group 5*

*“I found that a little confusing because I know they always tell you to anchor it. So, it’s anchored, so why is it still falling over?” — Participant in Group 6*

Many participants also focused on the drawers in the symbol, as in Symbol 1, stating that they thought the intended message was to close or lock drawers. Group 2 discussed that even if the dresser does not tip over fully, the drawers can fall out.

Group 6 overall thought that this symbol was indicating to *not* mount a dresser to the wall, a critical confusion. Some of this group thought the symbol was indicating that the anchor was dangerous, or that you should not trust the anchor. One member of this group explained that they understood the symbol correctly because they were aware of a court case involving young children climbing on un-anchored lockers that fell and injured them.

<b>Suggestion</b>	<b>From</b>	<b>Quotes</b>
Show comparison of restraint and no restraint	Groups 1, 2, 5, & 6	<p>“I would get rid of the hardware in this one and let it be a tip hazard and then have one where it is installed. Without this it’s tipping, it’s top heavy. With this, it shows locked in place. Go back to your red check mark and your green check mark.” — <i>Participant in Group 1</i></p> <p>“I guess if you had combined the first panel of the dresser falling over with this panel then I understand that this thing is kind of holding it from tipping over. But without that first one for context I might not have understood that this was holding it to the wall.” — <i>Participant in Group 2</i></p> <p>“We seem to like the do/don’t, like the green and the red, so maybe if there are two pictures of a dresser, falling without it and then stable with it.” — <i>Participant in Group 5</i></p>

		<p>“Maybe you have two images and one shows it falling without anything there. And the other shows it with an anchor, to suggest you should have an anchor there.” — <i>Participant in Group 6</i></p>
<p>Improve the look of the bracket/restraint</p>	<p>Groups 3, 4, &amp; 5</p>	<p>“You could have a double panel where the first panel shows the restraint and then the second panel shows the furniture toppling over.”</p> <p>“Or maybe have the second panel be just of that restraint to show how the restraint should be set up.”</p> <p>— <i>Discussion in Group 3</i></p> <p>“I think [the bracket] would be bigger because not only is it small but it’s got the red outline to it and you really can’t see it because it’s not big enough. So you know I would just enlarge the little latch thing and make it more visible for people that need glasses.” — <i>Participant in Group 4</i></p> <p>“Have a green check right on top of this bracket.” — <i>Participant in Group 5</i></p> <p>“I think this bracket wasn’t going to hold it. I thought that’s why there was an arrow on it.” — <i>Participant in Group 5</i></p>
<p>Avoid confounding the image with the child</p>	<p>Groups 5 &amp; 6</p>	<p>“It all will probably be better without the child on it because it’s making a mixed message for me with the child on it. Maybe if I see the kid missing and the doors even shut, it would make more sense to me.” — <i>Participant in Group 6</i></p>


### *Symbol 7 Summary*

Symbol 7 showed poor comprehension, with only 55% of respondents correctly interpreting the symbol according to strict scoring and 63.8% with lenient scoring. There was only one critical confusion, but many non-critical incorrect interpretations. As with Symbol 1, a redesign that combines the strengths of each of the furniture tip-over hazard symbols and improves them could result in higher levels of comprehension.

## Symbol 8: Stay Within Arm’s Reach

### Cognitive Interview Booklet Elements

**Table 12a.** Percentage and frequency of correct responses to each element according to the grading rubric.

	Percent Correct (# correct)	Grading Rubric
What do you think this symbol means?	81.3% (65)	Stay within arm’s reach.
What should you do or not do in response to this symbol?	83.8% (67)	Stay within arm’s reach. (Implied but not essential: Do not walk away from changing table).
What could happen if you do not follow the symbol’s message?	80.0% (64)	Baby may fall and user would be too far to safely catch the baby.

### Overall Comprehension

**Table 12b.** Count and percent of correct and incorrect responses for Symbol 8.

	Count (n)	Percent
<b>Overall Correct</b>	71	88.8%
Strict Criteria	56	70.0%
Lenient Criteria	71	88.8%
<b>Overall Incorrect</b>	9	11.3%
Critical Confusions	0	
As a % of incorrect responses		0%
As a % of total responses		0%
<b>Total</b>	80	100%
<i>Fully correct response:</i>		
- Must mention staying an arm’s length away, or remaining in contact or close by, so that the child does not fall		
<i>Partially correct response (only mentions one or more of the following):</i>		
- Keep eyes on child		
- Do not leave child unattended (without mention of closeness or distance)		

*Focus Groups.* This symbol was somewhat clear according to focus group discussions. Some interpreted the symbol correctly as “stay within arm’s length,” and others were partially correct in thinking the symbol meant to watch or “keep eyes” on the baby. The discussions revealed that the dots that were supposed to indicate arm’s length introduced some confusion. Some participants stated that the dots also looked like a line of sight, and some thought the line of sight was “pointed” toward the table, as in the example quotes below.

*“I thought the lines were coming out of his eyes. ‘Don’t let your baby get out of sight.’” — Participant in Group 4*

*“I thought this one was kinda goofy. Because it’s telling you to look at the baby and not at the changing table – which is kinda weird.” – Participant in Group 3*

<b>Table 12c.</b> Focus group suggestions for Symbol 8.		
<b>Suggestion</b>	<b>From</b>	<b>Quotes</b>
Make “arm’s length” clearer	Groups 2 & 3	<p>“I think where the line terminates is too near his eyes. My initial thought was ‘looking at it’ but then I realized the person was closer, and it’s a distance thing.” – <i>Participant in Group 2</i></p> <p>“You could raise the child, the image of the child up so that the arm is reaching straight out instead of— and angle and then put the dotted line underneath so that it wouldn’t be eyesight but more arm distance.” – <i>Participant in Group 2</i></p> <p>“I would add dimensions. Like ‘two feet’ right above the dotted lines. To kind of show that this is the distance that you should be rather than lines of eyesight.” – <i>Participant in Group 3</i></p>
Show consequence, as in Symbol 9	Groups 1 & 3	<p>“I think maybe show the baby falling off. I think I would understand the seriousness of not watching the baby or not being close to them.” – <i>Participant in Group 3</i></p>
Show baby lying down	Group 4	<p>“What baby is sitting up on the changing table? [...] When you’re changing a baby on the changing table you need them to be flat so you can do what you need to do.” – <i>Participant in Group 4</i></p>


### *Symbol 8 Summary*

Although Symbol 8 scored high with comprehension with respect to the lenient, partially correct criteria (88.8%) and showed no critical confusions, this symbol failed comprehension criteria when scored strictly (70%). Many respondents incorrectly identified the meaning of this symbol as being related to line of sight or keeping one’s eyes on the child. Comprehension may improve if the symbol is redesigned to show the “arm’s length” line indicator below the arm rather than above the arm. Further, participants tended to prefer Symbol 9, which was similar but showed a baby falling as a consequence of the adult not being close enough to catch them quickly.

### Symbol 9: Stay Within Arm's Reach

#### Cognitive Interview Booklet Elements

**Table 13a.** Percentage and frequency of correct responses to each element according to the grading rubric.

	Percent Correct (# correct)	Grading Rubric
What do you think this symbol means?	80.0% (64)	Stay within arm's reach.
What should you do or not do in response to this symbol?	82.5% (66)	Stay within arm's reach. (Implied but not essential: Do not walk away from changing table).
What could happen if you do not follow the symbol's message?	96.3% (77)	Baby may fall and user would be too far to safely catch the baby.

#### Overall Comprehension

**Table 13b.** Count and percent of correct and incorrect responses for Symbol 9.

	Count (n)	Percent
<b>Overall Correct</b>	73	91.3%
Strict Criteria	58	72.5%
Lenient Criteria	73	91.3%
<b>Overall Incorrect</b>	7	8.8%
Critical Confusions	0	
As a % of incorrect responses		0%
As a % of total responses		0%
<b>Total</b>	80	100%
<i>Fully correct response:</i>		
- Must mention staying an arm's length away, or close by, so that the child does not fall		
<i>Partially correct response (only mentions one or more of the following):</i>		
- Keep eyes on child		
- Do not leave child unattended		

*Focus Groups.* This symbol was overall clear and well-liked. As with Symbol 8, some participants thought the dotted lines were meant to depict sight lines. However, the depiction of the baby falling in the second panel better communicated that maintaining a short distance (i.e., arm's length) from the table was important.

<b>Table 13c.</b> Focus group suggestions for Symbol 9.		
<b>Suggestion</b>	<b>From</b>	<b>Quotes</b>
Show a comparison with an adult too far away	Group 2, 5, & 6	<p>“If in the first picture, the baby wasn’t just calmly sitting but maybe getting caught because they’re right there, and in the second picture, they’re falling but they’re not caught because they’re too far.” — <i>Participant in Group 5</i></p> <p>“The only thing I would say about number nine is the person is still— It still has the baby in view, instead of too far away.” — <i>Participant in Group 6</i></p>
Depict child lying on table	Group 3	<p>“But just the fact of the baby sitting [not lying] on the changing table is not safe.” — <i>Participant in Group 3</i></p>


### *Symbol 9 Summary*

As with Symbol 8, this symbol passed comprehension testing when assessed against the lenient scoring criteria (91.3%) and critical confusion ( $n = 0$ ) but not strict scoring (72.5%). Also, as with Symbol 8, confusion emerged from the “arm’s length” line that was misinterpreted as a line of sight. Symbol 9 scored better than Symbol 8 but would similarly benefit from small changes to emphasize the “arm’s length” message (i.e., placed below rather than above the extended arm) and to avoid confusion with a line of sight.

**Symbol 10: Outdoor Grills**

*Cognitive Interview Booklet Elements*

**Table 14a.** Percentage and frequency of correct responses to each element according to the grading rubric.

	<b>Percent Correct</b> (# correct)	<b>Grading Rubric</b>
What do you think this symbol means?	68.8% (55)	Do not light a gas grill with the lid closed. Do light gas grill with the lid open.
What should you do or not do in response to this symbol?	63.8% (51)	Have the lid open when igniting the grill.
What could happen if you do not follow the symbol's message?	81.3% (65)	Serious burns.

*Overall Comprehension*

**Table 14b.** Count and percent of correct and incorrect responses for Symbol 10.

	<b>Count (n)</b>	<b>Percent</b>
<b>Overall Correct</b>	55	68.8%
Strict Criteria	45	56.3%
Lenient Criteria	55	68.8%
<b>Overall Incorrect</b>	25	31.3%
Critical Confusions	4	
As a % of incorrect responses		16.0%
As a % of total responses		5.0%
<b>Total</b>	80	100%
<i>Fully correct response:</i>		
- Must mention that you must light/ignite a grill with the lid open to avoid getting burned		
<i>Partially correct response (only mentions one or more of the following):</i>		
- Igniting a grill with the lid open could cause explosion or injury, but not burns		

**Table 14c.** Critical Confusion Statements and frequency of occurrence for Symbol 10.

<b>Critical Confusion Statement</b>	<b>Frequency</b>
Do not turn grill to "high" to light	<i>n</i> = 2
Ignite flame outward	<i>n</i> = 1
Do not light grill with match	<i>n</i> = 1

There were three different statements that we identified as critical confusions for Symbol 10. For each of these, following the misinterpretation could lead to lighting the grill with the lid closed and potential injury. Other incorrect responses focused on having the lid open at all times, which is not a

critical confusion because leaving the lid open at all times would also mean leaving the lid open while lighting the grill.

*Focus Groups.* Focus group discussions revealed that participants who had personal experience grilling were more likely to correctly identify this symbol’s meaning, whereas those who did not know how to grill were less likely to understand it. This difference in grilling experience is exemplified in quotes below.

*“I kinda was confused because I don’t usually light my grill. So, I don’t really know what to do. But I guess you’re supposed to open it then light it? I wasn’t really sure.” — Participant in Group 3*

*“I saw it completely differently [from the rest of the group] because I never used a grill.” — Participant in Group 5*

Overall, the groups liked that the symbol contained two panels comparing the lid open and shut. The burning consequence of the hazards was clear, but it was less clear under what circumstances the grill lid should be open.

<b>Suggestion</b>	<b>From</b>	<b>Quotes</b>
Make ignition action clearer	Groups 1 & 5	<p>“So, what about four panels. You have a guy with an open lid and then successfully igniting it and then you have a guy down here with the lid closed, he hits the button and the lid blows. So instead of two guys you do four. I mean it’s a lot of room...” — <i>Participant in Group 1</i></p> <p>“Well, if they talk about igniting, that’s a button. You don’t see the button there at all, so I think one thing would be to have a picture of the button underneath it.” — <i>Participant in Group 5</i></p> <p>“If it had that universal power symbol. [...] That might get the idea of how that works. [...] So if that was more clear that that was like a ‘go,’ a start.” — <i>Participant in Group 5</i></p>
Show a comparison	Groups 2 & 3	<p>“Maybe getting rid of the fire and the burners on the grill. Just trying to simplify the picture to make it clearer. All you should show is pressing the button with the lid open and one with the lid closed.” — <i>Participant in Group 2</i></p> <p>“Or if you had a picture where you try to light it and it doesn’t light. And then you turn the gas off and on and then try to light it and show the flames surge because the gas is built up. It doesn’t happen the way the symbol depicts it.” — <i>Participant in Group 3</i></p>

### *Symbol 10 Summary*

Symbol 10 performed poorly. Just over half (56%) of participants correctly comprehended this symbol according to strict criteria, and with lenient scoring criteria, comprehension was still significantly below passing (68.8%). This symbol also showed 4 (5%) critical confusions. Although the consequence of getting burned was clear, many participants did not understand how to prevent the hazard.




The action of “igniting” the grill could be made clearer by (more clearly) showing a person’s hand pushing the ignition button. It is important to clearly communicate the circumstances under which the grill’s lid should be open.

## Symbol 11: Laundry Pods

### Cognitive Interview Booklet Elements

**Table 15a.** Percentage and frequency of correct responses to each element according to the grading rubric.

	Percent Correct (# correct)	Grading Rubric
What do you think this symbol means?	88.8% (71)	Keep out of reach of children/Do not let children handle.
What should you do or not do in response to this symbol?	90.0% (72)	Keep out of a child's reach/Keep away from children.
What could happen if you do not follow the symbol's message?	92.5% (74)	Child may be injured (Implied but not essential).

### Overall Comprehension

**Table 15b.** Count and percent of correct and incorrect responses for Symbol 11.

	Count (n)	Percent
<b>Overall Correct</b>	75	93.8%
Strict Criteria	64	80.0%
Lenient Criteria	75	93.8%
<b>Overall Incorrect</b>	5	6.3%
Critical Confusions	0	
As a % of incorrect responses		0%
As a % of total responses		0%
<b>Total</b>	80	100%

*Fully correct response:*  
 - Must mention keeping away from children, or storing out of child's reach, or else the child may be injured

*Partially correct response (only mentions one or more of the following):*  
 - Do not leave containers open or allow children to remove items from jar (i.e., passive instead of active)

*Focus Groups.* Participants tended to understand the meaning of this symbol and shared few opinions in the discussion. Many participants indicated that they were familiar with news stories about ██████████ which contributed to their understanding of the symbol's meaning.


### Symbol 11 Summary

This symbol scored well. With strict scoring criteria, 80% of respondents correctly interpreted the symbol and there were no critical confusions. Symbol 11 might show even better comprehension if it were altered to additionally depict the importance of keeping the product on a high shelf out of a child's reach.

**Symbol 12: Furniture Tip-Over**

*Cognitive Interview Booklet Elements*

**Table 16a.** Percentage and frequency of correct responses to each element according to the grading rubric.

	Percent Correct (# correct)	Grading Rubric
What do you think this symbol means?	81.3% (65)	If a child climbs on this piece of furniture, the furniture may tip over.
What should you do or not do in response to this symbol?	66.3% (53)	Do not allow children to climb on the furniture
What could happen if you do not follow the symbol's message?	81.3% (65)	The furniture could fall/tip over onto the child.

*Overall Comprehension*

**Table 16b.** Count and percent of correct and incorrect responses for Symbol 12.

	Count (n)	Percent
<b>Overall Correct</b>	70	87.5%
Strict Criteria	51	63.8%
Lenient Criteria	70	87.5%
<b>Overall Incorrect</b>	10	12.5%
Critical Confusions	0	
As a % of incorrect responses		0%
As a % of total responses		0%
<b>Total</b>	80	100%

*Fully correct response:*  
 - Must mention a child/person climbing dresser (or climbing/standing on dresser drawers) and the furniture tipping/falling

*Partially correct response (only mentions one or more of the following):*  
 - Furniture tipping/falling because of open drawers  
 - Action is to supervise children (i.e., not actively preventing them from climbing)

*Focus Groups.* Participants tended to indicate that they liked how this symbol contained a prohibition symbol to communicate what not to do. Some participants additionally stated that they thought the prohibition symbol should be red instead of black. Group 2 discussed how, overall, they would prefer Symbol 1 if it also had the prohibition symbol present in Symbol 12.

**Table 16c.** Focus group suggestions for Symbol 12.

Suggestion	From	Quotes
Make prohibition symbol red	Groups 2, 3, 4, & 5	"I would rather the prohibition circle be red rather than black so it's more of a warning." — Participant in Group 2


		"I didn't like this one. I think if you guys were to use it that the circle and the slash should be red." — <i>Participant in Group 3</i>
--	--	---

### *Symbol 12 Summary*

This symbol showed poor comprehension by strict scoring criteria (63.8%) but passing comprehension when scored leniently (87.5%). There were no critical confusions. As with the other furniture tip-over symbols, Symbol 12 should be redesigned in conjunction with the others.

### Symbol 13: Strangulation Hazard

#### Cognitive Interview Booklet Elements

	Percent Correct (# correct)	Grading Rubric
What do you think this symbol means?	93.8% (75)	Cords may act as strangulation hazard.
What should you do or not do in response to this symbol?	91.3% (73)	Keep cords away from the baby.
What could happen if you do not follow the symbol's message?	85.0% (68)	May be strangled and die.

#### Overall Comprehension

	Count (n)	Percent
<b>Overall Correct</b>	75	93.8%
Strict Criteria	63	78.8%
Lenient Criteria	75	93.8%
<b>Overall Incorrect</b>	5	6.3%
Critical Confusions	1	
As a % of incorrect responses		20.0%
As a % of total responses		1.3%
<b>Total</b>	80	100%
<i>Fully correct response:</i>		
- Must mention keeping cords away from babies to avoid strangling (or choking)		
<i>Partially correct response (only mentions one or more of the following):</i>		
- Nonspecific injury		
- Only mentions specific cords (e.g., window blinds or electrical cords) and not baby monitor cords or general cords		

Critical Confusion Statement	Frequency
Do not wrap a cord around a baby's neck (i.e., active meaning)	<i>n</i> = 1

There was one statement that we identified as a critical confusion because the respondent indicated that the symbol meant "do not wrap a cord around a baby's neck." We decided that this could lead to potentially hazardous behavior because it refers only to the action of wrapping a cord, not to the passive result of leaving a cord where a child can reach it or become entangled.


*Focus Groups.* Many participants stated that they thought this symbol was clear and they tended to like it. Group 2 did show some confusion and one participant explained that they needed to use the context image to understand what the symbol meant. The other groups agreed internally on the correct meaning.

#### *Symbol 13 Summary*

Symbol 13 scored moderately poorly for comprehension. By strict criteria, 78.8% of respondents correctly understood the symbol, which is below the 85% criterion for passing. There was just one critical confusion. The results suggest that the placement on the product might play a large role in comprehension of the hazard, given that some participants stated they found the context image in the booklet confusing.

## Symbol 14: Keep Away From Children

### Cognitive Interview Booklet Elements

	Percent Correct (# correct)	Grading Rubric
What do you think this symbol means?	76.3% (61)	Keep away from children.
What should you do or not do in response to this symbol?	78.8% (63)	Keep out of a child's reach/Keep away from children.
What could happen if you do not follow the symbol's message?	73.8% (59)	Child may be injured (Implied but not essential).

### Overall Comprehension

	Count (n)	Percent
<b>Overall Correct</b>	64	80.0%
Strict Criteria	62	77.5%
Lenient Criteria	64	80.0%
<b>Overall Incorrect</b>	16	20.0%
Critical Confusions	0	
As a % of incorrect responses		0%
As a % of total responses		0%
<b>Total</b>	80	100%
<i>Fully correct response:</i>		
- Must mention keeping away from children or storing out of child's reach		
<i>Partially correct response (only mentions one or more of the following):</i>		
- Handling is hazardous to health, without mention of ingestion/injury		

**Focus Groups.** Every focus group talked about the small size of this image, tending to say that they could not see it well. People who did not see the symbol tended to focus their comments on the picture of the batteries. Over half of the participants who did notice the symbol tended to understand its intended meaning. Groups 2 and 3 commented that the image looked like it was a game of “keep-away” (keeping something away from a child).

Suggestion	From	Quotes
Change the format so it is easier to see	Groups 2, 3, 5, & 6	<p>“Why not just have a picture of a child with a prohibition symbol in front of it?” — <i>Participant in Group 2</i></p> <p>“The no baby icon would work better in this situation. Just have that. Don't let kids near this.” — <i>Participant in Group 3</i></p>

		<p><b>Mod: Is there a different way of depicting this that's easier to see or communicate better? Anything like that?</b></p> <p>"Make the picture bigger."</p> <p>"Use that circle with the X maybe."</p> <p>"But it— On that size, the circle with the X, then you wouldn't really even be able to see it, though."</p> <p>"I thought for the size and space, it was very good. But yeah, it is small."  — <i>Discussion in Group 5</i></p> <p>"Or maybe like the one above, it's red with the X through it."</p> <p>"And bigger, yeah."</p> <p>"It's much too small."</p> <p>"No, no, you don't want the X through it, because you want to keep it away."</p> <p>"Yeah."</p> <p>"You know what I mean, though."  <i>Discussion in Group 6</i></p>
--	--	--


### Symbol 14 Summary

Symbol 14 scored moderately poorly for comprehension. There were no critical confusions, but the symbol did not pass comprehension (85% or better) by either the strict (77.5%) or lenient criteria (80%). The small size seemed to be the biggest issue, which led some participants to focus their answers on the battery context image. The design of the symbol itself could also be changed so that it is easier to see at a smaller size — for example, depicting a child and age with a prohibition symbol.



## Symbol 15: Supervision Combination

### Cognitive Interview Booklet Elements

	Percent Correct (# correct)	Grading Rubric
What do you think this symbol means?	88.8% (71)	Do not leave child unattended
What should you do or not do in response to this symbol?	87.5% (70)	Stay with the child (while they are seated in the highchair).
What could happen if you do not follow the symbol's message?	57.5% (46)	Child may fall out of seat (Implied but not essential: and be injured).

### Overall Comprehension

	Count (n)	Percent
<b>Overall Correct</b>	72	90.0%
Strict Criteria	44	55.0%
Lenient Criteria	72	90.0%
<b>Overall Incorrect</b>	8	10.0%
Critical Confusions	2	
As a % of incorrect responses		25.0%
As a % of total responses		2.5%
<b>Total</b>	80	100%
<i>Fully correct response:</i>		
- Must mention that child may fall as a consequence of leaving the child unattended or walking away from the child		
<i>Partially correct response (only mentions one or more of the following):</i>		
- Child could be injured, not specifically by falling		
- Do not look away from the child		

Critical Confusion Statement	Frequency
Secure child before walking away	<i>n</i> = 2

Two respondents gave a similar response for Symbol 15 that was marked as a critical confusion, which was to secure the child before walking away. This interpretation is opposite the intended meaning, which is essentially to not walk away even if the child is secure.

*Focus Groups.* Overall, participants indicated that they liked this symbol. It was clear in the image that an adult was depicted as walking away from a child. However, some participants had expected to see the child depicted in a highchair, as in the context photograph, rather than “sitting on the floor” or “flying.”


<b>Table 19d.</b> Focus group suggestions for Symbol 15.		
<b>Suggestion</b>	<b>From</b>	<b>Quotes</b>
Show baby in a chair or product	Groups 3 & 6	<p>“I thought that was kind of weird. It’s like a person walking away from a baby sitting on the floor. So perhaps if they were in the seat, in one of the seats...”</p> <p>“I thought it was an odd picture, but I thought it meant, “Don’t put the baby in the seat and then walk away...”</p> <p>“Right – I did write that, but it seems odd to me that the baby would be depicted sitting on the floor. Unless they’re in something.”</p> <p>— <i>Discussion in Group 3</i></p>
Show consequence	Groups 5 & 6	<p>“Maybe show some of the dangers that they're worried about? Because, yeah, just being on the floor, like ‘don’t walk away from your child ever’ seems extreme. So maybe showing what's going on.” — <i>Participant in Group 5</i></p> <p>“Show the baby climbing out, or what could happen to the baby.” — <i>Participant in Group 6</i></p>
Show a comparison	Group 3	<p>“I think I’d like a yes or no symbol.”</p> <p>“Have the second part of the symbol with the parent turned to the baby and with an eyesight dotted line.”</p> <p>— <i>Discussion in Group 3</i></p>

### *Symbol 15 Summary*

This symbol showed poor comprehension according to strict scoring (55%) but “passing” comprehension according to lenient scoring (90%). The reason for this disparity is that many respondents indicated that the child could get hurt but did not mention falling specifically, as the rubric required. There were just two critical confusions. Comprehension could be improved by adjusting the appearance of the baby to ensure the symbol is depicting a child being left alone rather than an unsecure child, or by showing potential consequences of leaving the child unattended.

## Symbol 16: Always Use Restraints

### Cognitive Interview Booklet Elements

	<b>Percent Correct</b> (# correct)	<b>Grading Rubric</b>
What do you think this symbol means?	93.8% (75)	Buckle child/baby when using this product.
What should you do or not do in response to this symbol?	91.3% (73)	Make sure the child/baby is buckled when using product.
What could happen if you do not follow the symbol's message?	72.5% (58)	Child may fall out of seat (Implied but not essential: and be injured).

### Overall Comprehension

	<b>Count (n)</b>	<b>Percent</b>
<b>Overall Correct</b>	75	93.8%
Strict Criteria	58	72.5%
Lenient Criteria	75	93.8%
<b>Overall Incorrect</b>	5	6.3%
Critical Confusions	1	
As a % of incorrect responses		20.0%
As a % of total responses		1.3%
<b>Total</b>	80	100%
<i>Fully correct response:</i>		
- Must mention that child must be buckled to avoid falling		
<i>Partially correct response (only mentions one or more of the following):</i>		
- Child could be injured, not specifically by falling		

<b>Critical Confusion Statement</b>	<b>Frequency</b>
Your fingers can get caught	<i>n</i> = 1

We identified one critical confusion for Symbol 16, which was “your fingers can get caught.” We interpreted this response as a warning of the dangers of buckling a seatbelt, which could result in a person avoiding its use.


*Focus Groups.* Participants tended to state that they liked this symbol. There were few comments besides that the symbol was clear and easy to understand. Two groups (1 and 6) mentioned that this symbol could be construed as merely a suggestion because it does not seem to communicate danger, but there were no specific suggestions for improvement in the focus groups.

### *Symbol 16 Summary*

Symbol 16 showed poor comprehension according to strict criteria (72.5%) and higher, “passing” comprehension according to lenient criteria (93.8%). There was just one critical confusion. Similar to Symbol 15, there were substantially lower strict scores than lenient scores because the rubric requires that respondents specifically indicate that the child could fall as a consequence. Focus group discussions suggested that participants tended to correctly understand this symbol.

## Symbol 17: Age Warning Label

### Cognitive Interview Booklet Elements

	Percent Correct (# correct)	Grading Rubric
What do you think this symbol means?	83.8% (67)	Not for use by children ages 0 to 3 years
What should you do or not do in response to this symbol?	82.5% (66)	Do not allow children younger than three years of age to play with the toy. Only allow children 3 years of age or older to play with the toy.
What could happen if you do not follow the symbol's message?	88.8% (71)	Child could be injured (Implied but not essential).

### Overall Comprehension

	Count (n)	Percent
<b>Overall Correct</b>	67	83.8%
Strict Criteria	65	81.3%
Lenient Criteria	67	83.8%
<b>Overall Incorrect</b>	13	16.3%
Critical Confusions	5	
As a % of incorrect responses		38.5%
As a % of total responses		6.3%
<b>Total</b>	80	100%

*Fully correct response:*  
- Must mention that the product is not for ages 0-3 and that a child who is too young could be injured

*Partially correct response (only mentions one or more of the following):*  
- If the initial response was years, but raised the possibility it could be referring to months

Critical Confusion Statement	Frequency
For children 0-3 years	<i>n</i> = 3
Not for children ages 0-3 months	<i>n</i> = 2

Two responses for Symbol 17 were scored as critical confusions. One misinterpretation was that the symbol communicates an age range in months, with no reference to years. The other confusion was that the symbol communicates that the product is intended for children ages 0-3 years, which is opposite the intended meaning.

For scoring, we considered responses correct if they referred to the age as some variant of children three and over, children four and over, or not for children under three. A more detailed breakdown of the language used in these correct responses is in Table 21e below.

Responses	Count (n)
Children Four and Over	4
Children Three and Over	1
Children Over Three	1
Not for Children Three and Under	3
Not for Children Ages 0-3	25
No Children Under Three	29

*Focus Groups.* The groups frequently discussed whether this image was referring to months or years. Some were unsure, though most correctly guessed “years” in their booklet responses. Some participants suggested that the symbol include the word “months” or “years,” or the letter M or Y. However, responses to Symbol 20 suggest the letter M by itself could similarly be misinterpreted in this context.

Some participants said that their responses were influenced by the context image of a product that seemed like it was too small for a 3-year-old and too large (and advanced) for a 3-month old. Groups 2, 3, and 6 all commented that the baby in this symbol looked like a pumpkin, citing the hair curl as a distraction.


Suggestion	From	Quotes
Specify months or years	Groups 2, 4, & 6	“I think there needs to be a specification of a Y or an M.” – <i>Participant in Group 2</i> “I would put years next to the numbers or maybe a Y.” – <i>Participant in Group 4</i>
Show a comparison	Groups 3 & 5	“Maybe something that showed a happy baby being three plus and, I don’t know, an unhappy baby [...] falling off it.” – <i>Participant in Group 5</i> “Or even just have a yes panel with a kid and it says 3+ years or something.” – <i>Participant in Group 3</i>
Adjust how the baby looks	Group 3	“I would take out the hair curl.” “I would just have the head.” <b>Mod: Would you want to have a body as well?</b> “I think I’d want to see a silhouette of the baby like symbol one.” – <i>Discussion in Group 3</i>

### *Symbol 17 Summary*

This symbol showed moderate levels of comprehension (81.3% for strict and 83.8% for lenient scoring) but did not achieve passing criteria of 85%. There were also 5 (6.3%) critical confusions. Specifying “years” as the age metric could improve comprehension for this symbol.

## Symbol 18: Supervision, Drowning

### Cognitive Interview Booklet Elements

	<b>Percent Correct</b> (# correct)	<b>Grading Rubric</b>
What do you think this symbol means?	83.8% (67)	Supervise swimmers.
What should you do or not do in response to this symbol?	77.5% (62)	Make sure someone doesn't swim alone. Supervise people when they are using the pool.
What could happen if you do not follow the symbol's message?	78.8% (63)	Someone may drown and die.

### Overall Comprehension

	<b>Count (n)</b>	<b>Percent</b>
<b>Overall Correct</b>	67	83.8%
Strict Criteria	55	68.8%
Lenient Criteria	67	83.8%
<b>Overall Incorrect</b>	13	16.3%
Critical Confusions	4	
As a % of incorrect responses		30.8%
As a % of total responses		5.0%
<b>Total</b>	80	100%
<i>Fully correct response:</i>		
- Must mention supervising or watching swimmers/children to avoid drowning		
<i>Partially correct response (only mentions one or more of the following):</i>		
- Don't swim alone in pool		
- Consequence is a swimmer could get hurt		

<b>Critical Confusion Statement</b>	<b>Frequency</b>
No jumping/diving	<i>n</i> = 4

Four individuals gave responses that were marked as critical confusions. Specifically, they believed Symbol 18 communicates to not jump or dive in the pool. This interpretation could lead to potentially hazardous behavior by avoiding jumping but still swimming alone or not supervising other swimmers.

*Focus Groups.* Though many participants interpreted the meaning correctly, most tended to state that they did not like this image and found it distracting. Many of the groups joked that it was



“creepy,” and the person depicted as supervising looked more like an alien, goblin, vampire, or witch, while the swimmer looked like a monkey or a person dancing.

Some participants also commented that the waves did not look like water, but rather like brain waves, as if the person depicted were watching someone drown or causing someone to drown. One participant in Group 1 also thought that these waves were depicting electrical wires, and Group 6 discussed how it looked like the symbol communicates “don’t jump” in the pool because it seems to show shallow water. The groups generally suggested that this symbol be replaced by Symbol 19.


#### *Symbol 18 Summary*

Symbol 18 was generally disliked and overall it scored poorly. Many participants joked about how this symbol looked. When scored according to the lenient criteria, comprehension comes near to a passing score (83.8%), but not when judged according to the strict criteria (68.8%). Moreover, four respondents (5%) critically confused the symbol to mean “no jumping” or “no diving.” Many focus group participants immediately suggested replacing this symbol with Symbol 19, which they believe depicted the same hazard more clearly.

## Symbol 19: Supervision, Drowning

### Cognitive Interview Booklet Elements

**Table 23a.** Percentage and frequency of correct responses to each element according to the grading rubric.

	Percent Correct (# correct)	Grading Rubric
What do you think this symbol means?	90.0% (72)	Supervise swimmers.
What should you do or not do in response to this symbol?	87.5% (70)	Make sure someone doesn't swim alone. Supervise people when they are using the pool.
What could happen if you do not follow the symbol's message?	85.0% (68)	Someone may drown and die.

### Overall Comprehension

**Table 23b.** Count and percent of correct and incorrect responses for Symbol 19.

	Count (n)	Percent
<b>Overall Correct</b>	73	91.3%
Strict Criteria	63	78.8%
Lenient Criteria	73	91.3%
<b>Overall Incorrect</b>	7	8.8%
Critical Confusions	3	
As a % of incorrect responses		42.9%
As a % of total responses		3.8%
<b>Total</b>	80	100%

*Fully correct response:*

- Must mention supervising or watching swimmers/children to avoid drowning

*Partially correct response (only mentions one or more of the following):*

- Don't swim alone in pool
- Consequence is a swimmer could get hurt

**Table 23c.** Critical Confusion Statements and frequency of occurrence for Symbol 19.

Critical Confusion Statement	Frequency
No jumping/diving	<i>n</i> = 2
Supervise those who can't swim	<i>n</i> = 1

For Symbol 19, two respondents believed the symbol was communicating not to jump or dive in the water, which could still result in drowning in the absence of supervision. One respondent believed the symbol meant to supervise those who are unable to swim. We reasoned that this interpretation could give rise to the belief that it is unnecessary to supervise all swimmers.

*Focus Groups.* Participants generally said that they liked this image, especially in contrast to Symbol 18. Group 2 agreed that this symbol looked more like water than Symbol 18. Compared to Symbol 18, participants were more likely to identify the person in the water specifically as a child, as exemplified in the quotes below.

*“It shows the difference in size between the two people which kinda shows distance or that the other person is small. [...] This person is in water and the other one is looking or watching them.” — Participant in Group 3*

*“That’s the parent one [referring to 18], but this one means lifeguard on duty [referring to 19]. This one [18] means ‘parents supervise your kids otherwise they will drown.’” — Participant from Group 4*

However, one participant in Group 1 also thought the symbol was specifically showing “waist high” water, possibly explaining why some participants misunderstood this symbol to mean “no jumping or diving,” though Symbol 18 showed slightly more of those confusions.

<b>Suggestion</b>	<b>From</b>	<b>Quotes</b>
Specify that the supervisor is watching	Group 2	<p>“One thing that 18 does positively though is that it does show lines coming from the eyes. Even though they’re kind of drawn in a weird way it this just kind of shows that the whole head is pointing in one way.”</p> <p>“So maybe on 19 there should be an eye just watching the swimmer.”</p> <p>— <i>Discussion in Group 2</i></p>


*Symbol 19 Summary*

Comprehension for this symbol was better than for Symbol 18, but correct interpretations still failed according to strict scoring criteria (78.8%). The incorrect interpretations were largely because many respondents did not explicitly identify the possible consequence of drowning, which was required by the rubric. Overall, the symbol clearly communicated that there is a person swimming in water while another person is watching.

## Symbol 20: Intended for a Certain Age

### Cognitive Interview Booklet Elements

**Table 24a.** Percentage and frequency of correct responses to each element according to the grading rubric.

	Percent Correct (# correct)	Grading Rubric
What do you think this symbol means?	72.5% (58)	For use only with children between 0-36 months of age.
What should you do or not do in response to this symbol?	75.0% (60)	Do not use with children over 36 months of age.
What could happen if you do not follow the symbol's message?	67.5% (54)	Child could be injured. (Implied but not essential).

### Overall Comprehension

**Table 24b.** Count and percent of correct and incorrect responses for Symbol 20.

	Count (n)	Percent
<b>Overall Correct</b>	58	72.5%
Strict Criteria	47	58.8%
Lenient Criteria	58	72.5%
<b>Overall Incorrect</b>	22	27.5%
Critical Confusions	15	
As a % of incorrect responses		68.2%
As a % of total responses		18.8%
<b>Total</b>	80	100%

*Fully correct response:*  
- Must mention that the product is for children between 0-36 months of age or else the child could get hurt

*Partially correct response (only mentions one or more of the following):*  
- Consequence is that product could break, without mention of the child getting hurt

**Table 24c.** Critical Confusion Statements and frequency of occurrence for Symbol 20.

Critical Confusion Statement	Frequency
Maximum weight of child (n = 5)	n = 5
Maximum time in product (n = 3)	n = 3
Maximum weight and height of child (n = 3)	n = 3
Maximum height of child (n = 2)	n = 2
<b>Not</b> for children under 36 months (n = 1)	n = 1
Maximum height of product (n = 1)	n = 1

There was a total of 15 critical confusions for Symbol 20. These specific responses varied, but most misinterpretations could lead to product use by a child of the inappropriate age and result in injury. Several respondents believed the symbol was referring to the size of the child rather than the age. Three respondents interpreted the symbol as a maximum time to spend in the product, and one thought it references a maximum height of the product. One respondent interpreted the opposite meaning as intended, which is that the product was not for children under 36 months.

As with Symbol 17, the age-related answers that we scored as correct were phrased a few different ways. Below is a breakdown of the language used in correct responses. Though most correct responses referenced months, five participants referenced years in their responses.

Responses	Count (n)
For Children 0-36 Months Old	53
No Children Older Than Three	2
Children Under Three	3

*Focus Groups.* Many participants mistook the months label (“m”) as something besides months, or they guessed correctly but were unsure. Groups 2 and 5 talked about how they thought the “m” could denote a time limit for leaving a child in the product.

Suggestion	From	Quotes
Spell out months	Groups 1, 2, 4, & 6	<p>“I like the ‘MO’ better.” — <i>Participant in Group 2</i></p> <p>“I thought it meant 0-36 minutes. [Laughs] Don’t leave your baby in this for more than 36 minutes. I was like why would somebody leave their baby for 0 minutes.”</p> <p><b>Mod: Would you want to change this symbol in any way?</b></p> <p>“Put months, I guess. Yeah, ‘mo.’” — <i>Discussion in Group 4</i></p> <p>“The symbol ‘m’ could be meters or minutes. It’s a little bit confusing.” — <i>Participant in Group 6</i></p> <p>“It’s not clear with their measurements are, what they’re really warning you against.” — <i>Participant in Group 6</i></p>
Use years rather than months	Groups 2, 3, & 6	<p>“After twelve months, don’t use the months. Just use 1, 2, or 3.” — <i>Participant in Group 3</i></p> <p>“Maybe people wouldn’t know how to do the math too. Not everybody know that twelve months is one, twenty-four months is two...” — <i>Participant in Group 4</i></p>
Use a weight limit rather than age	Groups 2 & 6	<p>“One comment on this: why not put a weight limit rather than age?” — <i>Participant in Group 2</i></p>

### *Symbol 20 Summary*





















Symbol 20 did not pass comprehension criteria (85% or better) according to either strict (58.8%) or lenient (72.5%) criteria. There were many critical confusions ( $n = 15$ ) with several different misinterpretations, mostly from respondents misunderstanding the “m” label. To improve this symbol, the word “months” should be written in full or as a longer abbreviation (e.g., “mos”).

## Discussion

The goal of this project was to evaluate a set of twenty graphical safety symbols (ten newly developed and ten existing) for comprehension using a sample of 80 participants diverse in demographics and life experience. The open comprehension test procedures described in ANSI Z535.3 (2011; R2017) were used to collect quantitative data on interpretations and focus group discussions added additional information on participant opinions and suggestions.

According to the strict criteria, only two symbols achieved passing comprehension scores of higher than 85% and fewer than 5% critical confusions: Symbol 4 (Make sure (child's) restraint fits snugly) and Symbol 6 (Place baby on back to sleep (a suffocation hazard)).

The rest of the symbols did not pass the ANSI Z535 comprehension criteria. Among those that did not pass, we identified whether they scored moderately or scored poorly. The overall passing and failing of symbols are summarized below.

Symbol					
Pass/Fail	Fail (Moderate)	Fail (Poor)	Fail (Moderate)	Pass	Fail (Poor)
Symbol					
Pass/Fail	Pass	Fail (Poor)	Fail (Moderate)	Fail (Moderate)	Fail (Poor)
Symbol					
Pass/Fail	Fail	Fail (Moderate)	Fail (Moderate)	Fail (Moderate)	Fail (Moderate)
Symbol					
Pass/Fail	Fail (Moderate)	Fail (Moderate)	Fail (Poor)	Fail (Moderate)	Fail (Poor)

### **Poorest Performing Symbols**

For newly-developed symbols, the symbols that performed worst for comprehension were Symbol 2 (Methylene Chloride), Symbol 5 (never add soft bedding to a baby's sleep environment), Symbol 7 (install anti-tip restraint), and Symbol 10 (start grill with lid open), suggesting these especially need to be redesigned and retested to improve comprehension.

For existing symbols, the poorest-performing symbols were Symbol 18 (Supervision, drowning symbol from ATSM F2666 and ASTM F2729) and Symbol 20 (intended for a certain age). Symbol 18 will be discussed further in the section on recommendations for Supervision (Drowning) symbols. As discussed in the Results section, many participants misunderstood the meaning of Symbol 20 as referring the size of the child (in meters, or unspecified) rather than their age in months, and comprehension would likely improve by using the word "months" or using years.

### **Recommendations for Furniture Tip-Over Symbols**

Symbols 1, 7, and 12 were variants on furniture tip-over warning symbols. Symbol 12 is the one currently in use and Symbols 1 and 7 were variants being tested in the present research. All three symbols failed comprehension testing and Symbol 7 (Install anti-tip restraint) performed worst.

A combined symbol is recommended for improved comprehension. Symbol 1, with the addition of a prohibition symbol and a close-up depiction of the restraint, is the best starting candidate. It could be modified to communicate both the furniture-tip over hazard and the instruction to install anti-tip restraints through the use of the green "check" (for correct) and red x and/or prohibition symbols.

### **Recommendations for Stay Within Arm's Reach Symbols**

Symbols 8 and 9 were newly developed variants on the same message: "stay within arm's reach (of baby)." These symbols performed moderately poorly but Symbol 9 performed better and was better liked in the focus groups. Comprehension would be improved by showing the consequence of the baby falling, and by adjusting the look of the lines intended to depict "arm's length." The lines should be placed below the arm rather than above to reduce misinterpretation of the meaning as "line of sight."

### **Recommendations for Supervision (Drowning) Symbols**

Symbols 18 and 19 were existing symbols intended to communicate supervising swimmers to avoid drowning. Symbol 18 is from ASTM F2666 and ASTM F2729 and Symbol 19 is from ISO 20712. Though both performed moderately poorly, focus group participants overwhelmingly preferred Symbol 19 and suggested that this one is used without modification. Low comprehension scores for both of these symbols were largely because many respondents did not explicitly identify drowning as the possible consequence of this hazard; therefore, it may be beneficial to create symbol variants to test that more explicitly communicate drowning.



**Appendices**

**Appendix A: Cognitive Interview Booklet (Test Booklet)**

**COGNITIVE INTERVIEW BOOKLET**

Name (please print): \_\_\_\_\_

Today's Date: \_\_\_\_\_

v.-3276019  
3041-0136

**EXAMPLE OF AN INADEQUATE ANSWER**



Context: This symbol appears on machines used in the home and workplace.

What do you think this symbol means?

Gears and hand

What should you do or not do in response to this symbol?

Be careful

What could happen if you do not follow the symbol's message?

Could get hurt

**EXAMPLE OF A GOOD ANSWER**



Context: This symbol appears on machines used in the home and workplace.

What do you think this symbol means?

Caution. Moving Gears. Do not stick hand near machine while it is running.

What should you do or not do in response to this symbol?

I would stay away and not put my hand near the machine until someone stopped it.

What could happen if you do not follow the symbol's message?

My fingers or hand could be crushed by the moving gears.

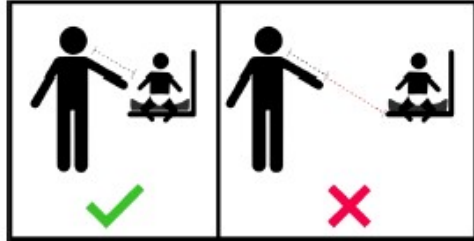


This symbol might appear on containers of laundry detergent packets.

What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?



This symbol might appear on baby changing tables or changing pads.

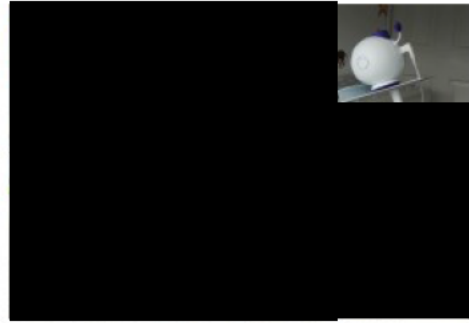
What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?



This symbol might appear on baby monitors.



What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?



This symbol might appear on above ground residential pools or portable pools.

What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?



This symbol might appear on infant sleep products, such as cribs, bassinets, and play yards.

What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?



0-36m



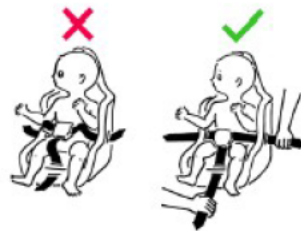
This symbol might appear on children's products such as infant chairs, baby bouncers, infant swings, or toys.

What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?





This symbol might appear on products like high chairs, infant bouncers, and other products with seating for a child.



What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?



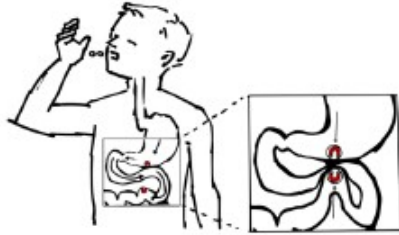
This symbol might appear on certain types of furniture, such as a dresser, chest or clothing storage unit.



What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?

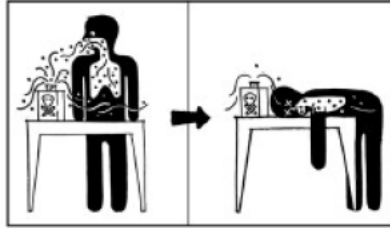


This symbol might appear on magnetic building sets or toys that contain small magnets.

What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?



This symbol might appear on container labels of chemical solvents, such as paint strippers or paint thinners.



What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?



This symbol might appear on various children's products, such as high chairs, baby changing products, strollers, or infant swings.

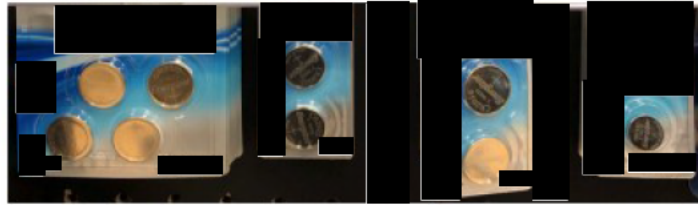
What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?



This symbol appears on potentially hazardous products, such as button cell batteries.



What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?



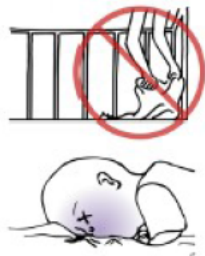
This symbol might appear on certain types of furniture, such as a dresser, chest or clothing storage unit.



What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?



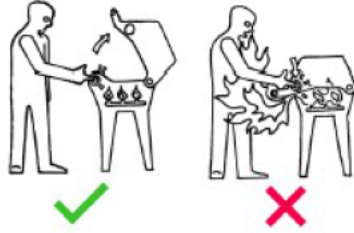
This symbol might appear on infant sleep products, such as cribs, bassinets, and play yards.

What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?





This symbol might appear on propane gas grills.



What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?



This symbol might appear on children's toys.



What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?



This symbol might appear on or near swimming pools.



What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?



This symbol might appear on certain types of furniture, such as a dresser, chest or clothing storage unit.



What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?



This symbol might appear on baby changing tables or changing pads.

What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?



This symbol might appear on children's products, such as high chairs, infant carriers, strollers, or infant swings.

What do you think this symbol means?

What should you do or not do in response to this symbol?

What could happen if you do not follow the symbol's message?

Please answer the following questions about yourself:

Age: \_\_\_\_\_ Sex: \_\_\_ Male \_\_\_ Female

Education: (check the option that best describes the highest level of education you have attained)

\_\_\_ some high school    \_\_\_ high school degree    \_\_\_ some college  
\_\_\_ 2-year college degree    \_\_\_ 4-year college degree    \_\_\_ master's degree  
\_\_\_ doctoral  
\_\_\_ other professional degree (please specify): \_\_\_\_\_  
\_\_\_ other degree (please specify): \_\_\_\_\_

Marital Status:

\_\_\_ Single    \_\_\_ Married    \_\_\_ Legally Separated    \_\_\_ Divorced

Children: \_\_\_ Yes    \_\_\_ No

(if yes: please indicate the number of children that live in your home, either full-time or part-time, and their ages in the space provided):

Race:

\_\_\_ Asian    \_\_\_ Black/African    \_\_\_ Caucasian  
\_\_\_ Hispanic/Latino    \_\_\_ Native American    \_\_\_ Pacific Islander  
\_\_\_ Mixed Race    \_\_\_ Prefer not to answer

Current occupation: \_\_\_\_\_

## Appendix B: Booklet Orderings

Original Ordering		Order 1		Order 2	
#	Symbol	#	Symbol	#	Symbol
1		11		16	
2		8		9	
3		13		1	
4		18		19	
5		6		17	
6		20		10	
7		4		5	
8		7		12	
9		3		14	
10		2		15	
11		15		2	
12		14		3	
13		12		7	
14		5		4	
15		10		20	
16		17		6	
17		19		18	
18		1		13	
19		9		8	
20		16		11	




Original Ordering		Order 3		Order 4	
#	Symbol	#	Symbol	#	Symbol
1		15		6	
2		1		16	
3		20	 	3	
4		11		12	
5		9	 	10	
6		19		8	 
7		2	 	18	
8		13		17	
9		7		5	
10		4		14	
11		14		4	
12		5		7	
13		17		13	
14		18		2	 
15		8	 	19	
16		10		9	 
17		12		11	
18		3		20	 
19		16		1	
20	 	6		15	

### Appendix C: Focus Group Details

Date, location and number of participants in each of the 6 focus group sessions.			
Focus Group Number	Date	Location	Number of Participants
1	7/24/19	Colonie, New York	8
2	9/03/19	Highwood, Montana	12
3	9/25/19	Troy, New York	3
4	9/26/19	Troy, New York	2
5	9/26/19	Colonie, New York	10
6	9/28/19	Colonie, New York	6

## Appendix D: Symbol Comprehension Testing Scoring Rubric

Symbol Comprehension Testing Rubric				
Symbols	Test Questions	What should you do or not do in response to this symbol?	What could happen if you do not follow the symbol's message?	
	<b>What do you think this symbol means?</b> If a child climbs on this piece of furniture, the furniture may tip over.	Do not allow children to climb on the furniture.	The furniture could fall/tip over onto the child.	
	If the fumes from this chemical are inhaled, it may result in unconsciousness, serious injury, or death.	Do not inhale fumes.	Loss of consciousness, serious injury, death	
	Ingesting magnets can cause them to attract within the digestive system and compress those tissues.	Do not swallow the magnets.	Serious injury (predominantly in the digestive track/intestines)	
	When using this child restraint device, the straps should be tight and secure, not loose.	Tighten the straps.	Child may be injured (Implied but not essential).	
	Do not put soft materials, such as blankets or pillows, in a baby's sleep environment. They may suffocate the baby.	Do not put blankets, pillows or other soft materials into a baby's sleep environment.	Child may suffocate and die.	
	Place baby on his/her/their back in a sleeping environment.	Place baby on his/her/their back in a sleeping environment.	Child may suffocate and die.	
	Secure wall restraint between the wall and piece of furniture to prevent tip over.	Install the wall restraint. (Implied but not essential: Make sure the restraint is secure.)	The furniture could fall/tip over onto the child.	
	Stay within arm's reach.	Stay within arm's reach. (Implied but not essential: Do not walk away from changing table.)	Baby may fall and user would be too far to safely catch the baby.	
	Stay within arm's reach.	Stay within arm's reach. (Implied but not essential: Do not walk away from changing table.)	Baby may fall and user would be too far to safely catch the baby.	
	Do not light a gas grill with the lid closed. Do light gas grill with the lid open.	Have the lid open when igniting the grill.	Serious burns.	
	Keep out of reach of children/Do not let children handle.	Keep out of a child's reach/keep away from children.	Child may be injured (Implied but not essential).	
	If a child climbs on this piece of furniture, the furniture may tip over.	Do not allow children to climb on the furniture	The furniture could fall/tip over onto the child.	
	Cords may act as strangulation hazard.	Keep cords away from the baby.	May be strangled and die.	
	Keep away from children.	Keep out of a child's reach/Keep away from children.	Child may be injured (Implied but not essential).	
	Do not leave child unattended	Stay with the child (while they are seated in the highchair).	Child may fall out of seat (Implied but not essential: and be injured).	