Misidentification of Non-Edible Household Products

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Abstract

In spite of improvements in product packaging and consumer education, reports of accidental ingestion of non-edible household products persist. Although medical professionals have noted their concerns with misleading product appearance and packaging in relation to accidental exposure, there is little experimental evidence that such products are actually likely to be mistaken for innocuous items. The purpose of this study was to determine whether a product's appearance contributes to mistaken inferences about its intended use. 168 college students viewed randomly-ordered computer images of actual retail products with all text digitally removed from the packaging; their task was to identify each product solely on the basis of its appearance. It was hypothesized that non-edible products with a potentially misleading appearance (e.g., a clear bag of multicoloured mothballs) would be mistakenly identified as the edible or innocuous control products they

resembled (e.g., a clear bag of multicoloured candies). Results from Study 1 indicated that ambiguous product images were identified significantly less accurately, less confidently, and more slowly than control products of similar appearance and were frequently mistaken for those products. These results were replicated in Study 2 with an expanded stimulus set and a longer viewing time, and in Study 3 with participants categorizing (rather than identifying) the products' best use as representing either personal consumption, personal hygiene, household chores, or outside chores/pest control. The most worrisome confusions across studies were between non-edible and edible products such as lamp oils mistaken for juice, or household cleaners misidentified as sports drinks. Attributes of product appearance such as the shape of the package, the colour of its contents, and the nature of the graphics on the label appeared to lead to confusion across product categories. Future research should manipulate package and product design characteristics to identify factors that minimize the likelihood of individuals misidentifying non-consumable household products.

Keywords: consumer education, misleading product appearance, ambiguous products, product identification, product categorization, accidental poisoning, accidental ingestion, household products, cleaning products, consumer products resembling food, child-appealing products

Misidentification of Non-Edible Household Products

Each year, more than 1 million cases of unintentional poisonings involving children less than 5 years of age are reported to U.S. poison centres (Gutierrez, Negron, and Garcia-Fragoso, 2011). Studies of childhood poisoning cases treated at U.S. hospital emergency rooms (Franklin and Rodgers, 2008) and calls to the U.K.'s National Poisons Information Service (Williams, Moyns, Bateman, Thomas, Thompson, and Vale, 2012) indicate that most poisonings occur at home to children 5 years of age or under and involve ingestion of common household products such as multipurpose cleaners and detergents. Although only a very small percentage of accidental ingestions of household products in developed countries results in serious clinical outcomes (Williams et al., 2012), such accidents create considerable stress, uncertainty, and worry for caregivers.

Important precautionary measures have been taken in recent years to reduce the prevalence of unintentional poisonings. For example, the Poison Prevention Packaging Act (PPPA), passed in the U.S. in 1970, required child-resistant caps on medications (Jacobi, 1983), a practice that resulted in significant reductions in both the mortality rate for children's accidental ingestion of oral prescription drugs (Rodgers, 1996) and emergency room visits involving accidental ingestions of PPPA-regulated products (Walton, 1982). Required child-resistant packaging has been extended to several products since passage of the PPPA: For example, Temple and Smith (1994) reported a 67% decrease in the number of ingestions of furniture polish by U.S. children under 5 in 1982 relative to 1972, the year in

which furniture polishes were required to incorporate child-resistant packaging. Nevertheless, many potentially harmful household products such as bleaches, cleaners, detergents, and personal care items are not regulated by the PPPA (Franklin and Rodgers, 2008) and thus not required to use special packaging.

For individuals who cannot read, adding warning graphics to potentially harmful products has been employed to reduce accidental exposures; however, their effectiveness has been questioned (Duncan and Dempsey, 2010; Pooley, Hon, and Fiddick, 2010). For example, an early study comparing the effectiveness of the "Mr. Yuk" sticker (a cartoon face with tongue sticking out), a skull and crossbones, or no picture on children's' attraction to a product indicated that pictorial warnings did not significantly reduce attraction to products and may have actually made the product more interesting to some children (Schneider, 1977). Brown (2012) noted that such warning graphics are no longer recommended because of the attention they draw to the product.

Aside from child-resistant packaging and warning labels, other aspects of a product's packaging and appearance may influence how individuals respond to a product not intended for ingestion. The European *Scientific Committee on Consumer Safety* (SCCS, 2011) suggested that product features such as colour, packaging, and label imagery may increase the likelihood of a household item being mistaken for food or drink. For instance, the colour of an item can be appealing to a young child because it either resembles the actual physical colour of a food (e.g., a liquid cleaner resembling the colour of juice) or is a brighter, more

attractive colour. Likewise, a household cleaning product label might use the image of a food item, such as an orange, to suggest a particular scent, increasing the likelihood that an individual will mistake the cleaner for a beverage due to the shared imagery.

The medical literature has reported several examples of products with perceptual attributes that appeared to mislead individuals as to their intended use. For instance, *Fabuloso*, a brightly coloured multipurpose household cleaner with fruit on the label to depict its scent, was the source of 94 cases of unintentional ingestion reported to the Texas Poison Centre from January 1, 2006 to April 20, 2006, leading to speculation by the authors that the item's packaging could make it easy to mistake for a beverage (Miller, Levsky, Masneri, and Borys, 2006). Although there have been changes to the packaging since the original report, a recent *Consumer Reports* (2014) update suggested, "Fabuloso products have child-proof caps, but the products' bright colours, fruity fragrances, and labels showing apples, pears, and other fruit, could make them more enticing to curious children than other cleaners." Examples of other non-food products that medical researchers have speculated are attractive because of their appearance include single-load laundry detergent pods, which may look like candy (Centers for Disease Control and Prevention, 2012), mothballs, which resemble coconut candies (Presgrave, Camacho, and Boas, 2008), and smokeless tobacco pellets, which resemble breath mints (Connolly, Richter, Aleguas, Pechacek, Stanfill, and Alpert, 2010).

Although medical and public health professionals have noted their concerns with misleading product appearance and packaging in relation to accidental exposure (e.g., Nedunchelian, 2009; SCCS, 2011), we have been unable to find experimental evidence demonstrating that such products are actually likely to be mistaken for innocuous items. The present series of studies attempted to determine whether non-edible products with a potentially confusing appearance are indeed likely to be misperceived. Digital images of household retail products were briefly presented to U.S. college students. All writing was removed from the images, thus eliminating text as a basis of identification. The basic question was whether toxic products with a potentially misleading appearance (e.g., coloured lamp oils) would be mistaken for similar-looking edible or innocuous control products (e.g., fruit juices).

Participants

168 college students with normal or corrected-to-normal visual acuity participated in one of three studies. The sex distribution across the studies was 72.6% female and 27.4% male, and the median age was 20 years (M = 20.7 years, SD = 4.6). The research was approved by the college's Institutional Review Board.

Study 1

The goal of this pilot study (n = 22) was to determine whether consumer products with a potentially misleading appearance are actually perceived that way by observers.

Method

Vision Screening. During the course of the testing session, a computer-based version of the *Acuity Screening Inventory* (*ASI*), a brief, reliable, and valid screening tool for measuring uncorrected visual acuity, was administered to assess participants' self-reported visual ability (Coren and Hakstian, 1989). The *ASI* consists of 10 items, each of which allows for a 5-alternative graded response. Scores on the ASI range from 10 – 50, with higher scores indicating worse self-reported uncorrected visual acuity. Eight participants reported wearing glasses or contact lenses (presumably resulting in vision corrected to normal or near-normal acuity). The remaining 14 participants with uncorrected vision had a median *ASI* score of 12.0 (*M* = 14.3, *SD* = 5.9), equivalent to a Snellen acuity value of 20/20 or better.

Stimuli. Twenty images of retail products such as foods, drinks, personal hygiene items, household cleaning products, and lawn care items were obtained online via a Google Images search during the Fall of 2012. Pictures of the products were placed into one of three categories: Ambiguous (the 6 items in this category were selected for their potentially misleading appearance), Normal (each of the 6 items in this category was matched to an Ambiguous stimulus in general appearance and size, but deemed as likely to be correctly identified), or Filler (the 8 items in this category were different in appearance from items in the first two categories and selected for their likely correct identification). The Filler stimuli were used to create a broader range of easy-to-identify products (e.g., cereal, bar soap) and were not included in the analyses. For each stimulus, all visible writing on the product container and label was either erased (blended into the background colour) or blurred. All

other graphical aspects (e.g., design elements, icons, pictorial drawings) were preserved (see **Figure 1** below for examples of altered product images). Note that a ***Supplement*** provides additional details about stimuli and data analysis aspects of this research project (e.g., images of all Study 1 stimuli can be found in *Supplementary Table 1*)

Figure 1. Examples of Ambiguous (left column) and Normal (right column) stimuli from Study 1, with writing erased or blurred on the product packaging. Top row (left to right): multicoloured mothballs and crème mints candy; Middle row: all-purpose cleaners and sports drinks; Bottom row: antifreeze and fruit juice. Photos obtained via Google Images search, Fall, 2012.

Digital images of the products were modified with Photoshop image editing software and saved as .jpg files no larger than 500 x 500 pixels. Each file was saved in proportion to its original dimensions (e.g., a 600 x 403 file would be resized to 500 x 335). Each stimulus was presented in the upper central portion of a 1024 x 768 program window on PC computers with Windows operating systems and 19-inch colour monitors. The computer program used to present the stimuli and record the participants' responses was created in Macromedia Authorware.

Procedure. Participants were tested at individual computer stations, with instructions, stimulus presentation, and response recording controlled by computer. The 20 altered product images were presented in a completely randomized order determined for each participant. An image appeared for 1 second then disappeared as a text box appeared at the bottom of the screen for typing the identification. Using the example of a container of yogurt, the instructions noted that one could simply type "yogurt" in the text box and not the actual brand name or type of yogurt (e.g., peach yogurt).

After identifying an image, participants were asked to indicate how confident they were in the identification by using a 1 ("Not at all confident") to 7 ("Highly confident") Likert rating scale. Participants could take as long as needed and were able to view images at their own pace by clicking a button whenever they were ready for the next item. **Figure 2** contains a sequence of screenshots illustrating a typical product image identification trial.

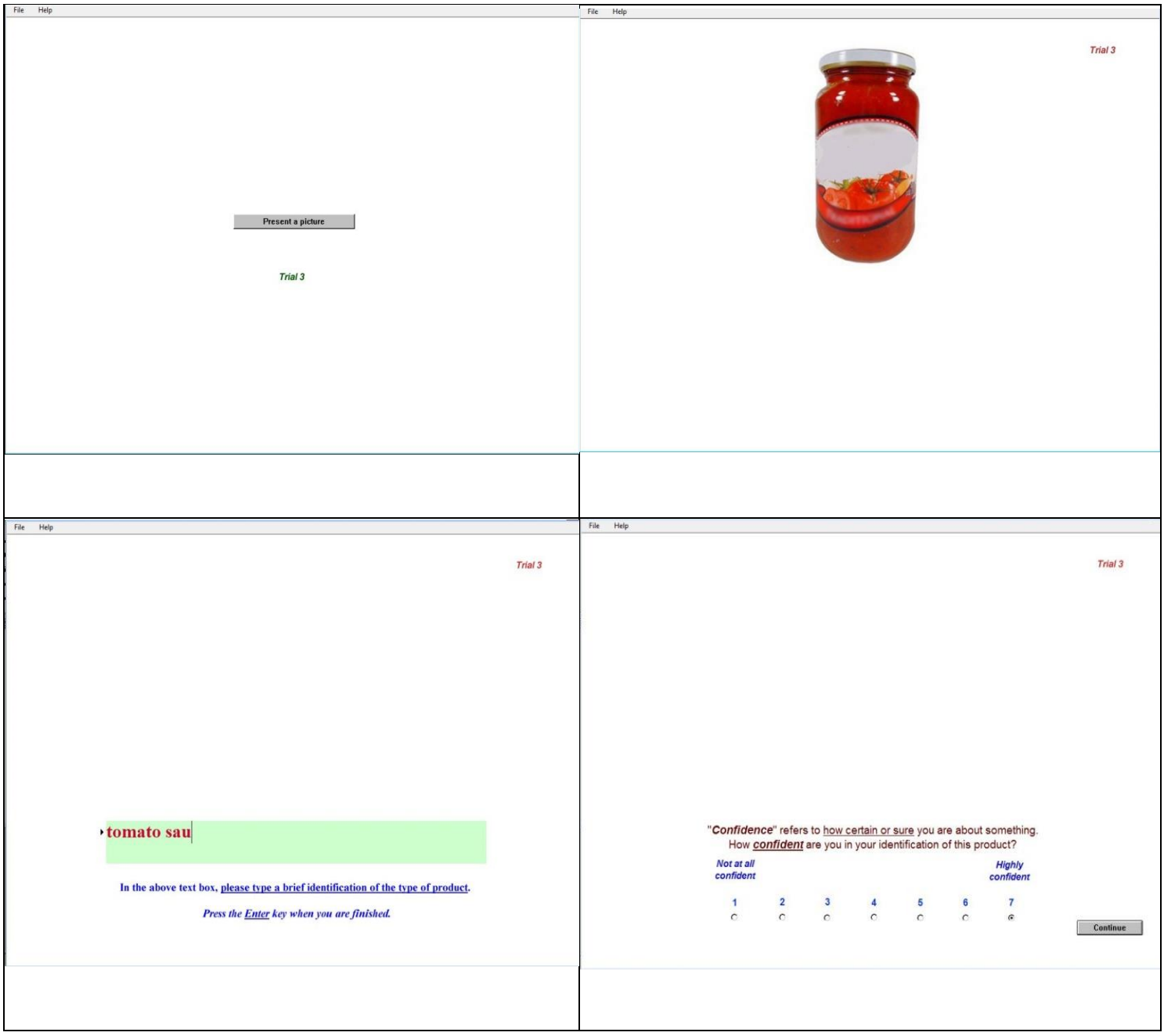

Figure 2. Sequence of screenshots from Study 1 created in Macromedia Authorware: *(Upper Left)* When participant clicks the button, a stimulus is presented; *(Upper Right)* The stimulus (tomato sauce, a product from the Filler Stimulus category) is presented for 1 second; *(Lower Left)* A textbox then appears for typing the product identification; *(Lower Right)* A Likert scale then appears for rating confidence in the identification.

Following the experimental task, questions about gender, age, vision (*ASI*), and the number of distractions experienced during the session were presented in a random order. The question about distractions ("The number of distractions in my current surroundings could be described as…") was accompanied by a 7-point Likert scale with the numbers 1, 4, and 7 labelled "Very Low", "Average", and "Very High," respectively. A single-sample *t*-test revealed that the actual distraction rating (M = 3.2, SE = 0.3) was significantly below the expected (mid-scale "average") distraction rating of 4, $t(21) = -2.737$, $p < .012$, two-tailed, suggesting that the participants were attentive to the task at hand.

Demographic questions were followed by a textbox in which participants were given an opportunity to submit any feedback they had about the study. The study concluded with a written debriefing and thank-you presented on the computer, followed by a verbal debriefing with the experimenter. The median amount of time taken to complete the computer-based portion of the study (not including consent and verbal debriefing) was 8.2 min (M = 8.4 min, SD = 1.9).

Design and Dependent Variables. A simple two-condition design was employed with type of stimulus (Ambiguous, Normal) as the within-subjects independent variable. Three dependent variables were measured: accuracy of identification, rated confidence of identification, and response time.

Identification responses were independently scored by the experimenters as correct or incorrect. To be scored as correct, the response needed to be conceptually consistent

with the type of product. For instance, scoring guidelines indicated that acceptable identifications of a can of insecticide spray would include generic responses such as "bug spray," "insect repellent," or "pesticide" as well as specific, category-appropriate product names like "Raid;" examples of unacceptable identifications would include generic, out-of-category responses such as "deodorizing spray," "air freshener," or "hair spray," and specific but category-inappropriate responses like "Febreeze" or "Lysol." Misspelled words were ignored. Responses that were too vague to allow placement into a specific category (e.g., "spray," which could refer to either bug spray or air freshener) were counted as incorrect, and disagreements were discussed and resolved by consensus. Each participant contributed two identification scores to the primary analysis, the number of correct responses to the six Ambiguous and the six Normal stimuli.

Confidence in an identification response was measured using a 1 to 7 Likert scale, and each participant contributed two scores to this analysis, the mean confidence ratings to the six Ambiguous and six Normal stimuli. Response time was recorded in seconds and measured from the onset of the picture to the completion of the confidence rating. Because response time can be positively skewed by a lapse of attention leading to an overly long response, the median response time across the six stimuli in each category served as the measure for this analysis.

Results and Discussion

Primary Analyses. Two-tailed repeated measures *t* tests, with the alpha level set at .05, were used to compare performance on the sets of Ambiguous and Normal stimuli for the three dependent variables. Participants correctly identified fewer Ambiguous (*M* = 1.55, *SE* = 0.21) than Normal (*M* = 5.91, *SE* = 0.06) stimuli, *t*(21) = -19.519, *p* < .0001, Cohen's *d* = 4.16. Participants were also less confident in their identifications of Ambiguous (*M* = 4.62, *SE* = .21) than Normal (*M* = 6.24, *SE* = .12) stimuli, *t*(21) = -9.438, *p* < .0001, *d* = 2.01, as well as slower in completing their identifications and ratings of Ambiguous (*M* = 12.20s, *SE* = 0.69s) than Normal (*M* = 9.55s, *SE* = 0.53s) stimuli, *t*(21) = 3.369, *p* = .003, *d* = 0.72. Individual inspection of the six pairs of Ambiguous and Normal items revealed that 5 of the 6 Ambiguous items were identified more slowly and with less confidence than the paired Normal items. The exception was the bag of mothballs, which was actually (mis)identified faster than the corresponding bag of candy, and with equal certainty. It seems likely that for this item, both the graphic of a smiling teddy bear - a cartoon item that has child-appealing properties (SCCS, 2011) - and the colourful items in the clear bag contributed to the high confidence and rapid speed of misidentification.

To summarize, analyses supported the hypothesis that products with a potentially misleading appearance would be mistakenly identified more often than control products. The analyses also indicated that these products were identified with significantly lower levels of confidence and slower responses. The effect sizes for accuracy and confidence were particularly large (Gravetter and Wallnau, 2011).

Secondary Analyses. Follow-up analyses were conducted to determine whether the overall inaccurate identification of the set of Ambiguous stimuli (25.8% correct) characterized each item in the set. These analyses, which are described in detail in *Supplementary Table 2,* revealed that five of the six Ambiguous stimuli were unsuccessfully identified. Three of these stimuli yielded clear modal responses that had been anticipated and used as the basis for selecting the matched Normal product: The bag of multicoloured mothballs was mistaken for a bag of candy and the tube of adhesive was mistaken for a tube of toothpaste by all 22 participants, and the all-purpose cleaners were mistaken for beverages by all 17 participants who misidentified the product. Although the modal incorrect response to insecticide spray was, as expected, air freshener (n = 4), the remaining 12 incorrect responses varied widely (e.g., cooking spray, bathroom cleaner, flat tire fixer). The one misidentified Ambiguous stimulus that was not frequently mistaken for its paired Normal product was antifreeze, which was most often mistaken instead for a household cleaning product or liquid soap (n = 14) rather than fruit punch.

To summarize, this study indicated that briefly-presented pictures of non-consumable products sans text were frequently mistaken by college students for innocuous products. The misidentifications were made with less certainty and more hesitancy than the accurate identifications of the normal products they resembled, suggesting that their appearance was confusing to participants.

Study 2

Study 2 incorporated improvements in sample size, number of stimuli, and design and procedural details to provide a stronger empirical test of the notion that consumer products with an Ambiguous appearance will be inaccurately identified. The design and procedural changes implemented in Study 2 were as follows:

- Exposure time: During the previous study a product image was exposed for 1 second, a duration that was clearly sufficient for near-perfect Normal product identification. Even though research in visual perception indicates that individuals readily glean the "gist" of a complex scene in a glance well under 1 second (Rousselet, Joubert, and Fabre-Thorpe, 2005), it is possible that identification of products with a confusing appearance would benefit from the greater accumulation of detail that occurs with additional study time (Tatler, Gilchrist, and Rusted, 2003). In Study 2, half of the participants were allowed triple the amount of time to view the stimuli.
- Memory demand: In Study 1, a product image disappeared before the individual could begin typing an identification response, a procedure that may have created an unnecessary memory demand. In Study 2, the stimulus and the textbox were presented simultaneously, a procedure that lessened memory demand by allowing the respondent to begin typing as soon as he or she was ready.
- Response time: In the previous study, the measurement of response time began with the onset of the picture and included both the identification response and

the confidence rating. It is unclear, then, whether the slower response to Ambiguous items reflected a slower identification, a slower confidence rating, or both. Study 2 provided a more direct index of item identification speed by measuring response time from the onset of the picture to the completion of the typed identification response.

The primary research questions in Study 2 (*n* = 69) were these: a) Would the pattern of inaccurate identification, low confidence, and slow responding to Ambiguous product images in Study 1 be replicated with a new and larger set of stimuli?, and b) Would providing additional viewing time result in improved identification of Ambiguous product images?

Method

Screening for Random Responders. The data were screened for "random responders" (Osborne and Blanchard, 2011), operationally defined here as any participant who responded with a blank (e.g., spacekey press), gibberish, or a "don't know" typed identification response on more than 25% of the trials and who also finished in the fastest 25% of the sample. Application of these criteria resulted in the data of one participant (not included in the sample of 69) being excluded from the analyses.

Vision Screening. 33 of the 69 participants reported on the *ASI* that they had corrected vision (i.e., wearing glasses or contact lenses). The 36 participants with

uncorrected vision had a median *ASI* score of 13.5 (*M* = 16.1, *SD* = 7.4), which is equivalent to a Snellen visual acuity score of 20/20 or better (Coren and Hakstian, 1989).

Stimuli. New product images were obtained from a Google Images search conducted in the spring of 2013 (*Supplementary Table 3*). Twenty images were placed into each of the three product categories (Ambiguous, Normal, or Filler) described in Study 1, and the 60 photos were modified and edited as before (see **Figure 3** on the next page for examples).

Figure 3. Examples of Ambiguous (left column) and Normal (right column) stimuli used in Studies 2 and 3, with writing removed from product packaging. Top row (left to right): Rose fragrance insecticide spray and blossom air freshener spray; Middle row: Lamp oils and fruit juices; Bottom row: Berries air freshener crystals and dried berries. Photos obtained via Google Images search, Spring, 2013.

Procedure. All testing procedures were identical to Study 1 with the following exceptions: a) Each participant was randomly assigned to either a 1-second or 3-second image presentation time; and b) The product image and textbox appeared simultaneously rather than sequentially (see **Figure 4** on the next page for a screenshot from a typical trial).

The picture disappeared after either the presentation time had elapsed or (if the response was faster than the allowed 1 or 3 seconds) the participant had finished typing the identification response.

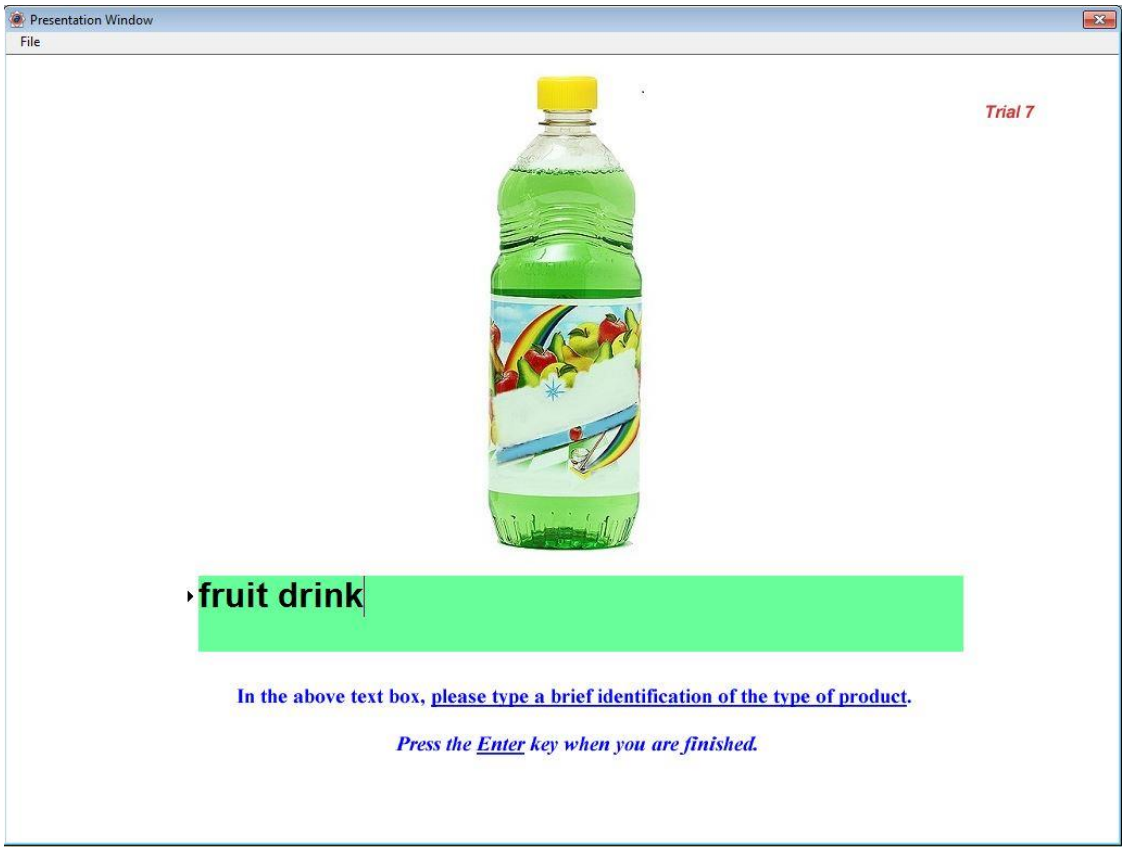

Figure 4. Screenshot from Study 2 created in Macromedia Authorware. Green multi-purpose cleaner (a product from the Ambiguous Stimulus category) is displayed simultaneously with a textbox in which the participant types an identification of the product. The stimulus remained on screen for either 1 s or 3 s (or less if the participant quickly completed the typed response and pressed the "Enter" key), and the textbox remained on screen until the participant completed the response. *Note: The first screenshot of Figure 2 (the start trial button) and the last screenshot of Figure 2 (the confidence rating scale) were also used on each trial of Study 2 but are not repeated here.*

The median amount of time taken to complete the experimental task was 15.2 minutes (*M* = 16.1 min, *SD* = 3.7 min). Participants appeared to be engaged in the study: A single-sample *t*-test revealed that the average distraction rating during the study was significantly below the expected distraction rating of 4 on a 7-point scale: *M* = 2.4 (*SE* = 0.2), $t(68) = -10.000$, $p < .0001$, two-tailed.

Experimental Design and Dependent Variables. A 2 x 2 mixed factorial design was used with type of stimulus (Ambiguous, Normal) as the within-subjects variable and stimulus exposure time (1s, 3s) as the between-subjects variable. Three dependent variables were measured: Identification responses were categorized as correct or incorrect using a slightly modified version of the scoring guidelines from Study 1. As before, to be scored as a correct identification, the response needed to be conceptually consistent with the type of product. For instance, examples of acceptable responses to the picture of a clear container of liquid red furniture polish included "wood polish" and "cleaning product," and examples of unacceptable responses included "cherry cough syrup," "mouthwash," "cranberry cocktail," and "hand soap." Descriptive but vague responses that focused only on appearance (e.g., "red liquid") were scored as incorrect, and misspelled words were ignored. Unlike Study 1, a slightly more lenient scoring of responses was used with the blue antifreeze and windshield washer stimuli: Any car-based cleaning or coolant response was scored as correct for either stimulus. Responses were independently and blindly scored by the

experimenters, and disagreements that were not errors (50 of the 4200 responses, or 1.2% of the total) were discussed and resolved.

Confidence in identification responses was measured as before, and response time was measured from the onset of the picture to the completion of the typed identification response, making it a more direct measure of the time needed for identification.

Results and Discussion

Primary Analyses. The results indicated a strong tendency for participants to mistakenly identify non-edible products with a misleading appearance (see left-hand side of **Table 1** on the next page for means and standard errors in each experimental condition). The analysis of identification accuracy revealed a significant main effect of type of stimulus, $F(1, 67) = 1359.040$, $p < .0001$, $\eta_p^2 = .953$, in which fewer Ambiguous products were accurately identified ($M = 7.34$, $SE = 0.31$) than Normal products ($M = 18.12$, $SE = 0.11$). There was a marginally significant main effect of exposure time, $F(1, 67) = 2.699$, $p = .105$, $\eta_p^2 = .039$, in which participants in the 3s group tended to be about a half item more accurate in their identification of products ($M = 13.03$, $SE = 0.26$) than those in the 1s group ($M = 12.43$, $SE = 0.26$). The interaction of type of stimulus and exposure time was not significant, $F(1, 67) = 0.429$, $p = .515$, $\eta_p^2 = .006$.

Table 1. Dependent Variable Means and Standard Errors for Identification (Study 2) and Categorization (Study 3) of Products Displayed for 1 or 3 Seconds

Study Time	**Study 2** *(Identification, n = 69)*		**Study 3** *(Categorization, n = 77)*	
	Type of Product		**Type of Product**	
	Ambiguous	**Normal**	**Ambiguous**	**Normal**
	Mean Number of Correct Identifications *(maximum = 20)*		**Mean Number of Correct Categorizations** *(maximum = 20)*	
1 second	6.94 (0.44)	17.91 (0.16)	9.67 (0.36)	17.24 (0.21)
3 seconds	7.74 (0.44)	18.32 (0.16)	10.26 (0.40)	17.94 (0.23)
	Mean Confidence Rating *(1-7 scale)*		**Mean Confidence Rating** *(1-7 scale)*	
1 second	4.18 (0.16)	5.56 (0.12)	5.37 (0.13)	6.25 (0.08)
3 seconds	4.18 (0.16)	5.70 (0.12)	5.62 (0.15)	6.44 (0.09)
	Mean Response Time *(seconds)* [a]		**Mean Response Time** *(seconds)* [a]	
1 second	7.48 (0.45)	6.08 (0.35)	4.16 (0.15)	3.47 (0.09)
3 seconds	8.55 (0.46)	6.66 (0.36)	4.90 (0.16)	3.83 (0.10)

Note. The standard error is in parentheses next to the mean.

[a] Although each participant submitted two *median* response time scores to the analysis, the summary values from the analysis are the means calculated on those response time scores.

The analysis of confidence ratings revealed a significant main effect of type of stimulus, $F(1, 67) = 437.689$, $p < .0001$), $\eta_p^2 = .867$, in which participants were less confident in their identifications of Ambiguous products ($M = 4.18$, $SE = 0.11$) than Normal products

(*M* = 5.63, *SE* = 0.08). Neither the main effect of viewing time, $F(1, 67) = .151$, $p = .699$, $\eta_p^2 = .002$, nor the interaction effect, $F(1, 67) = 1.028$, $p = .314$, $\eta_p^2 = .015$, was significant. Review of individual stimuli indicated that the pattern of lower confidence in identifying Ambiguous items was present for 19 of the 20 stimulus pairs.

The analysis of median response times revealed a significant main effect of type of stimulus, $F(1, 67) = 69.495$, $p < .0001$, $\eta_p^2 = .509$, in which Ambiguous products were identified about 1.5s more slowly (*M* = 8.01s, *SE* = 0.32s) than Normal products (*M* = 6.37s, *SE* = 0.25s). Neither the main effect of viewing time, $F(1, 67) = 2.338$, $p = .131$, $\eta_p^2 = .034$, nor the viewing time x type of stimulus interaction, $F(1, 67) = 1.535$, $p = .220$, $\eta_p^2 = .022$, was significant. Review of individual stimuli indicated that the pattern of slower identification of Ambiguous items was present for 17 of the 20 stimulus pairs.

Secondary Analyses. Follow-up analyses were conducted to determine whether the overall poor accuracy in identifying Ambiguous products was characteristic of each item in the set. The analyses, described in detail in *Supplementary Table 4*, indicated that 17 of 20 Ambiguous stimuli were significantly misidentified, and for 11 of these 17 products, the dominant response was indeed the one that had been anticipated and used as the basis for selecting the paired Normal product (e.g., 81% of the individuals who misidentified the image of lemon all-purpose cleaner mistook it for cooking oil). The other six misidentified products tended to yield a mixture of responses (e.g., although mistaken for a tomato-based sauce by only two participants, strawberry cocktail shower gel was nevertheless seen as an

edible but alcohol-related product such as “bloody Mary mix,” or “margarita mix” by most other participants).

In summary, non-edible products with a confusing appearance tended to be mistaken for similar-looking edible products when writing was removed from product images, a strong replication of the results of Study 1 with an expanded set of stimuli. As before, identifications of Ambiguous products were slower and made with lower confidence than identifications of Normal products, suggesting that participants experienced hesitancy and uncertainty when attempting to identify these products by their appearance alone. There was only weak support for the notion that additional viewing time would facilitate product identification in general, and there was no support for the hypothesis that extra viewing time would be especially beneficial in identifying Ambiguous products.

Study 3

Perhaps Ambiguous products in Studies 1 and 2 were poorly identified because individuals were required to *generate* specific descriptions, a task that may be more demanding than required in everyday life and especially challenging for items with a confusing appearance. From this perspective, does an individual really need to be able to label, for instance, the type of cleaner (is it a kitchen drain deodorizer? floor cleaner? toilet bowl cleaner? dishwashing liquid?), or is it simply sufficient for an individual to demonstrate an understanding that the product is used for household chores and is neither edible nor advisable for personal hygiene?

It is also possible that at least part of the poor outcome in identifying Ambiguous stimuli in Studies 1 and 2 was an artifact of the identification scoring guidelines employed. For instance, scoring guidelines for liquid all-purpose cleaners tagged "dish soap" as an imprecise and inaccurate identification response because that is not the product's typical use (there are other products, including one of the Filler items, that exist for the specific purpose of washing dishes). Although from this perspective "dish soap" is an inaccurate identification of a liquid household cleaner, it is nevertheless a more accurate and less worrisome response than, say, "fruit juice" or "sports drink," a distinction not made in traditional item identification scoring guidelines, but one that is addressed in Study 3 by using a categorization procedure.

The purpose of Study 3 was to assess participants' understanding of products using a potentially less-demanding multiple-choice classification approach in which the participant selected the single most appropriate category from a list of four predefined categories: Personal Consumption, Personal Hygiene, Household Chores, and Outside Chores or Pest Control. Study 3 required participants to make a broad, functional classification of the product (e.g., categorize a spray can with a flowers graphic as belonging to the Household Chores category) rather than generate a specific product use (e.g., "air freshener"). The multiple-choice format more closely resembles a recognition than recall procedure, which sometimes results in a more sensitive assessment of knowledge (Ozuru, Briner, Kurby, and McNamara, 2013; Postman, Kruesi, and Regan, 1975). Furthermore, the use of

predetermined response categories eliminates the large variability found in verbal responses and simplifies the task of scoring.

The major research questions in Study 3 (*n* = 77) were these: a) Will recognition of Ambiguous products improve with the multiple-choice categorization procedure?, and b) Will this procedure reveal a benefit of additional viewing time in the categorization of Ambiguous products?

Method

Vision Screening. A file conversion error occurred during data collection, resulting in lost data for some of the demographic variables (*ASI* score, distraction rating, and session length) stored in the Excel file; fortunately, no experimental data were affected. However, vision screening results were not available for Study 3.

Response Categories and Stimuli. Response categories, along with examples of products in each category, were devised to accommodate placement of the 60 stimuli, which were unchanged from Study 2. **Figure 5** on the next page shows the four response categories as they appeared on a typical trial.

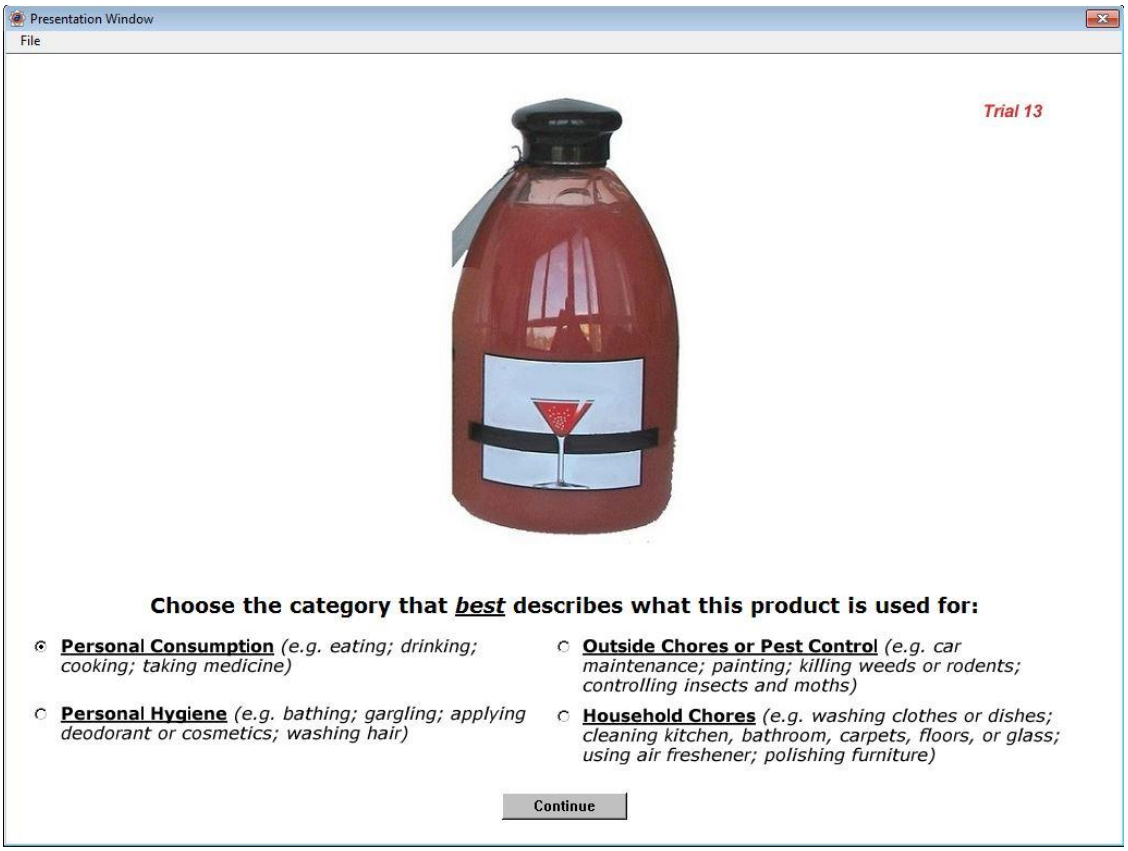

Figure 5. Screenshot from Study 3 created in Macromedia Authorware. Strawberry cocktail shower gel (a product from the Ambiguous Stimulus category) is displayed simultaneously with a multiple-choice question requiring the participant to categorize the use of the product. The order in which the categories were listed on the screen was determined randomly for each participant. The stimulus remained on screen for either 1 s or 3 s (or less if the participant quickly selected a category and clicked the "Continue" button), and the text remained on screen until the participant selected the response category. *Note: The first screenshot of Figure 2 (the start trial button) and the last screenshot of Figure 2 (the confidence rating scale) were also used on each trial of Study 3 but are not repeated here.*

Procedure. The instructions from Studies 1 and 2 were altered as needed to accommodate the new multiple-choice response procedure. Participants were familiarized with the response alternatives that would appear under each stimulus and were asked to take some time to review the examples of products in each category. Instructions indicated

that the four categories, their descriptions, and their locations on the screen would remain unchanged over the study, and that the participant's goal on each trial was to select the single category that best described what the product is used for. Instructions also noted that the four response categories would not be used an equal number of times over the course of the study. The experimental task required a forced-choice response in which the participant could not progress to the next stimulus until a selection had been made. Additional details concerning the counterbalancing of response alternatives can be found in the *Counterbalancing Supplement*. The typical session length was estimated to be approximately 15 minutes.

Experimental Design and Dependent Variables. The experimental design and two of the three dependent variables were unchanged from Study 2 (accuracy of categorization replaced accuracy of identification). A response was tallied as correct if the product was placed into the best-fitting category determined by agreement of the two authors prior to the data collection. Examples of correct categorizations include fruit juice and candy being placed in the Personal Consumption category, shower gel and deodorant in the Personal Hygiene category, multi-purpose cleaner and air freshener in the Household Chores category, and antifreeze and insect spray in the Outside Chores or Pest Control category. Each participant contributed two categorization scores to the analyses, the number of correctly categorized Ambiguous and Normal items.

Results and Discussion

Primary Analyses. Participants mistakenly categorized the appropriate use of products with an ambiguous appearance (see the right-hand side of **Table 1** on page 22). The analysis of categorization accuracy revealed a significant main effect of type of stimulus, $F(1, 75) = 615.138$, $p < .0001$, $\eta_p^2 = .891$, in which Ambiguous products were categorized less accurately ($M = 9.96$, $SE = 0.27$) than Normal products ($M = 17.59$ $SE = 0.15$). There was also a significant main effect of exposure time, $F(1, 75) = 4.342$, $p = .041$, $\eta_p^2 = .055$, in which participants in the 3s group tended to be about a half item more accurate in their overall categorization of products ($M = 14.10$, $SE = 0.23$) than participants in the 1s group ($M = 13.45$, $SE = 0.21$) . The interaction of type of stimulus and exposure time was not significant, $F(1, 75) = 0.035$, $p = .853$, $\eta_p^2 = .000$, indicating that the roughly half-item improvement in categorization accuracy in the 3s condition did not differ for Ambiguous and Normal stimuli. The exposure time results paralleled those of Study 2, confirming that there is a small effect (about a half-item benefit) of additional viewing time on product identification in general, with no special benefit in identifying Ambiguous products.

The analysis of confidence ratings revealed a significant main effect of type of stimulus, $F(1, 75) = 165.913$, $p < .0001$), $\eta_p^2 = .689$, in which participants were less confident in their category placement of Ambiguous ($M = 5.49$, $SE = .10$) than Normal ($M = 6.344$, $SE = .06$) products. Review of individual stimuli indicated that the pattern of lower confidence in identifying Ambiguous items was present for 16 of the 20 stimulus pairs. Interestingly, participants were considerably more confident in their answers to Ambiguous products in

Study 3 than Study 2 (1.3 points more confident on a 7-point scale), a pattern that is consistent with the higher accuracy demonstrated, and perhaps the greater ease experienced, on the categorization task. The main effect of viewing time, $F(1, 75) = 2.271$, $p = .136$, $\eta_p^2 = .029$, and the interaction effect, $F(1, 75) = 0.178$, $p = .674$, $\eta_p^2 = .002$, were not significant.

The analysis of median response time revealed a significant main effect of type of stimulus, $F(1, 75) = 93.299$, $p < .0001$, $\eta_p^2 = .554$, in which Ambiguous products were categorized about .9s more slowly ($M = 4.53$s, $SE = 0.11$s) than Normal products ($M = 3.65$s, $SE = 0.07$s). Review of individual stimuli indicated that the pattern of slower categorization of Ambiguous items was present for 17 of the 20 stimulus pairs. The analysis of response time also revealed a significant main effect of stimulus exposure time, $F(1, 75) = 11.925$, $p = .001$, $\eta_p^2 = .137$, that was qualified by a significant interaction effect, $F(1, 75) = 4.261$, $p = .042$, $\eta_p^2 = .054$. As can be seen in the right-hand side of Table 1 (page 22), although participants took longer to categorize both types of products in the 3s than the 1s condition, the slowing of response was twice as long for Ambiguous products (.74s difference) than Normal products (.37s difference). Finally, the average difference in response times across studies (participants responded about 3.5s faster to Ambiguous items in Study 3 than Study 2) is not surprising: One would expect that scanning and clicking one of four predefined categories for product placement should be executed faster than generating and typing a description of the product.

Overall, responses to Ambiguous products were slower and less confident than responses to Normal products, reinforcing the earlier conclusion that participants experience hesitancy and uncertainty as well as lower accuracy when attempting to categorize confusing products on the basis of their appearance alone.

Secondary Analyses. Follow-up analyses were conducted to determine whether the overall poor accuracy in categorizing Ambiguous products was characteristic of each item in the set. The outcomes of these analyses paralleled those of Studies 1-2 and are presented in detail in *Supplementary Table 5*.

In summary, when writing was removed from non-edible products with a confusing appearance, there was a strong tendency to inaccurately categorize their use. However, accuracy with Ambiguous stimuli actually improved somewhat with the new response procedure: Participants correctly categorized, on average, 2.6 more Ambiguous items in Study 3 than were correctly identified in Study 2. This finding suggests that asking participants to select a single best category for a product will yield a more sensitive index of their understanding of the product's use than asking them to generate a typed identification. Although there was modest support for the notion that providing additional time to study product images facilitates their classification *in general* (there was about a half-item benefit, the same as in Study 2), there was no support for the hypothesis that extra viewing time would be especially beneficial in correctly categorizing Ambiguous products.

General Discussion

In each of three studies, non-food household products with a misleading appearance were frequently mistaken for edible products by college students. Furthermore, participants tended to respond more slowly and with lower confidence to ambiguous than normal-looking items, suggesting a degree of confusion about the products' appearance and intended use. The slower and less confident responses may have reflected "product incongruity" that occurs when a viewed item does not fit well with expectations that the viewer has about items in that product category (Noseworthy, Cotte, and Lee, 2011). Research on categorization of "ambiguous" products (products that do not readily fit into a single category) suggests that when presented with conflicting conceptual and perceptual cues, consumers may rely on the product's appearance (particularly if it is a familiar-looking item) to make inferences about the product's category membership (Gregan-Paxton, Hoeffler, and Zhao, 2005). In the current study, college participants who viewed ambiguous-looking products (e.g., air freshener crystals that resembled hard candy), with no text to cue the product's identity, tended to misidentify the product as candy and categorize it in a manner that was consistent with its functional appearance (for "personal consumption"). It seems reasonable to hypothesize, for instance, that young children who cannot read, elderly individuals with diminished perception or cognition, or literate individuals who are multitasking, distracted, or in a hurry, might also fail to comprehend or notice an ambiguous product's warning label (or product description or danger graphics)

and rely instead on its misleading perceptual attributes, such as the familiar shape of the container or the incongruent graphics on the package, to guide their use of the product. Related research indicates that low-literate consumers depend heavily on pictorial information in products (Viswanathan, Torelli, Xia, and Gau, 2009). For example, when presented a fictitious fabric softener product with product warning statements ("Keep away from children. If it gets into your eyes, wash well with water….") and incongruent pictorial information (e.g., a mother kissing her smiling baby), low-literate individuals with a 0-4th grade- equivalent background displayed poorer comprehension of the warning statements than higher-literate individuals and were more influenced by the pictorial information in their answers to questions about the product (Jae and Viswanathan, 2012).

Table 2 on the next page lists items from the set of 20 Ambiguous products that were repeatedly misperceived across *both* Studies 2 and 3. For instance, the table indicates that 87% of the respondents in Study 3 categorized air freshener crystals as a Personal Consumption product, with respondents in Study 2 typically identifying that item as "candy," "fruit snacks," or "berries." We consider the 14 items in this table to be worrisome items, products whose misidentification and miscategorization could negatively impact physical health if acted upon (e.g., deciding that lamp oil or a household cleaner could be consumed as a sports drink).

Table 2. Products That Were Miscategorized and Misidentified across Studies 2 and 3

Ambiguous Stimulus	Percentage of Respondents Miscategorizing Stimulus [a]	Worrisome Miscategorization(s) [b]	Worrisome Misidentification(s) [c]
Strawberry cocktail shower gel	100.0%	Personal Consumption	BloodyMary/martini/ cocktail/margarita mix
Mothballs (multicoloured)	96.1%	Personal Consumption Personal Hygiene	Candy, gum balls
Rose fragrance insecticide spray	94.8%	Household Chores	Air freshener, disinfectant
Berries air freshener crystals	87.0%	Personal Consumption	Candy, fruit snacks, berries
Insecticide spray	83.1%	Household Chores	Cleaning product, air freshener, disinfectant
Windshield washer [d]	63.6%	Household Chores	Cleaning product, bleach, liquid soap/detergent
Lamp oils	62.3%	Personal Consumption Personal Hygiene	Fruit juice, energy drink, liquid soap
Antifreeze	57.1%	Household Chores Personal Consumption	Cleaning product, liquid soap, beverage
Orange stain and odor remover	46.8%	Personal Consumption	Orange juice, orange drink
Mothballs (white)	45.5%	Personal Consumption Personal Hygiene	Candy, breath mints
All-purpose cleaner (green)	41.6%	Personal Consumption Personal Hygiene	Fruit juice, fruit drink, soda
Lemon oil furniture polish	28.8%	Personal Consumption Personal Hygiene	Alcohol (e.g., vodka), lemon juice, mouthwash
Cinnamon-raspberry furniture polish	26.0%	Personal Consumption Personal Hygiene	Beverage, mouthwash, body wash/soap
All-purpose cleaner (blue)	20.8%	Personal Consumption Personal Hygiene	Fruit juice, fruit drink, sports drink

Table 2 *(continued)*

Note. The 14 stimuli listed in this table are products with an ambiguous appearance that were significantly misperceived by participants in both Studies 2 and 3. A "worrisome" miscategorization or misidentification is one that could directly and negatively impact physical health if it were acted upon (e.g., deciding that lamp oil could be consumed as an energy drink).

[a] This column shows the percentage of responses from Study 3 (n = 77) that were accounted for by the category or categories in that row. For example, in the second row, 96.1% of the 77 respondents placed multicoloured mothballs in the Personal Consumption or Personal Hygiene categories.

[b] The first category listed in this column is the category from Study 3 that captured the largest number of participants' worrisome incorrect responses. If a second category is listed, then it accounted for at least two or more of the worrisome responses.

[c] This column contains examples of the most common types of worrisome misidentifications made by participants in Study 2 (n = 69). For example, in the first row, the dominant identifications of strawberry cocktail shower gel included bloody Mary, martini, or cocktail/margarita mix.

[d] Windshield washer was a car care item in the Outside Chores or Pest Control category. Although it was significantly misperceived in both studies as a Household Chores item, we believe that if it were incorrectly used for activities such as cleaning bathrooms, there would likely be little direct impact on personal health.

It should be noted that the table contains only a representative, not an exhaustive, list of non-food household products with a potentially misleading appearance. New products are constantly introduced and old products changed, and there are numerous items that we did not assess in this study, such as dishwasher powder and tablets (Bertinelli, Hamill, Mahadevan, and Miles, 2006), medicines and vitamins (Wilkerson, Northington, and Fisher, 2005), dissolvable nicotine pellets and strips (Forrester, 2013), and soaps that look like fruits (European Commission, 1987).

Here are a few thoughts about the products in Table 2:

- Strawberry cocktail shower gel is an example of a personal care item such as soap or a hair care product, the third largest category of non-drug products responsible for unintentional paediatric ingestion poisonings treated in emergency rooms (Rodgers, Franklin, and Midgett, 2012). Data from the two most recent years of calls to U.S. Poison Control Centres indicate that cosmetics and personal care products were responsible for the most exposure calls involving children under 5 (Bronstein, Spyker, Cantilena, Rumack, and Dart, 2012; Mowry, Spyker, Cantilena, Bailey, and Ford, 2013). For the shower gel stimulus in the current study, the cocktail glass graphic and the gel's thick, reddish appearance would appear to be the item's most salient features given its universal interpretation as Personal Consumption product by college student participants. Although it is unlikely that very young children would mistake the strawberry cocktail shower gel for an alcoholic product such as a bloody Mary mix, it seems reasonable to assume that they would either ignore the graphic or interpret it as a glass and, like a handful of the college participants in our study, focus on the gel itself and mistake the product for a non-alcoholic beverage like juice or an edible food like sauce.
- Multicoloured mothballs in a clear package were universally mistaken for candy or gumballs, and white mothballs in a clear package with the picture of a moth on the front were frequently mistaken for candy, mints, or breath mints. The main active ingredient in mothballs is naphthalene or paradichlorobenzene,

insecticides that are regulated in the U.S. by the Environmental Protection Agency [some mothballs, particularly from abroad, also include camphor (Bates, 2002)]. According to the EPA, naphthalene incident exposures have averaged about 1600 per year, with the majority of these being children under 6 who ingested loose mothballs indoors (Environmental Protection Agency, 2008). The EPA report recommended that mothballs be packaged in a way that would discourage their eating by children (e.g., in sachets with tear-resistant wrapping or plastic containers that allow volatilization but no contact). Although the multicoloured and white mothball images used in this study were of products made in China that are illegal in the U.S. (Environmental Protection Agency, 2012), they are sold in many non-Western developing countries, which also typically report a larger number of accidental insecticide and pesticide poisonings than developing countries (Kohli, Kuttiat, Lodha, and Kabra, 2008; Wananukul, Sriapha, Tongpoo, Sadabthammarak, Wongvisawakorn, and Kaojarern, 2007).

- The two insect spray stimuli (one in a metal aerosol can and the other in a plastic pump bottle) were items in the Outdoor Chores/Pest Control category that were frequently mistaken for an air freshener, disinfectant, and (in the case of the pump bottle), household cleaner. The source of misperception for the insect spray in a pump spray bottle seems straightforward: the container's shape and spray head closely resembles many typical household spray cleaners. The other insect spray (aerosol can with flower graphics and a rose colour) clearly

resembles the type of container and graphic design of several air fresheners. Although spray products are not likely to be ingested by individuals, they nevertheless contain hazardous chemicals that contribute cumulatively to indoor air pollution (Rahman and Kim, 2014). Their mistaken use as air fresheners, disinfectants, or cleaners could contribute more immediately to eye irritation, respiratory reaction, or unnecessary dermal contact through "cleaned" surfaces.

- The package of air freshener crystals was widely mistaken for an edible product like "candy," "fruit snacks" or "berries." This seems to be a reasonable error given that the pictures on the package portrayed fruit and an open-mouth jar containing red crystals that look like pieces of hard candy. Although the U.S. National Poison Data System does not include air fresheners in its database, the U.K. National Poisons Information Service, which does include that category, found that it constitutes the third largest category of phone calls to poison centres about household products (Williams et al., 2012). We are not aware of scientific studies documenting accidental consumption of solid air fresheners, nor are we familiar with its toxicity if ingested (although this type of product often does not list the ingredients, it usually includes warnings such as "Product is not food"; "Do not eat";' "Keep out of reach of children and pets"; "If swallowed, do not induce vomiting - seek medical advice immediately"). Given the presence of informal consumer product reviews (e.g., http://tinyurl.com/m8wgzcm), it seems likely that at least a few individuals

outside of Great Britain have mistakenly ingested solid air freshener products. There appears to be a growing tendency to package these items in a food-like manner: We recently found three additional examples of ambiguous-looking solid air fresheners currently in U.S. stores, two that that are packaged in a manner resembling hard candy and one whose packaging resembles a jar of preserves.

- Antifreeze and windshield washer are car care products in the Outside Chores/Pest Control category that were typically mistaken for household cleaners and detergents. If accidentally used for a chore like cleaning the bathroom or washing clothes, there may be little direct negative impact on personal health other than dermal contact. However, antifreeze and windshield washer (including de-icing fluid) are products that may be perceived very differently by children and college students due to their different knowledge bases. Such products often have a sweet smell and taste and are frequently marketed in translucent containers with visible fluids in bright colours such as blue, green, pink, red, orange, and yellow. When formulated with ethylene glycol or methanol, they can be toxic even when ingested in low amounts (Patočka and Hon, 2010). In the U.S., these products are required to have child-resistant packaging; nevertheless, it is important to remember that child-resistant caps are not always child-proof (Franklin and Rodgers, 2008; National Capital Poison Center, 2013), and that accidental ingestions can also occur

through carelessness and unsafe storage (e.g., not securing the cap after use; transferring the fluid to insecure containers; using older containers in which the paper labels have come off). White, Litovitz, Benson, Horowitz, Marr-Lyon, and White (2009) studied 6450 cases of ethylene glycol ingestion by children under 5 reported to U.S. poison centres from 1995-2005. Their analyses indicated that paediatric ingestions declined over the 10-year period, that a small number (16) of the cases had life-threatening outcomes, and that there were no significant differences in the frequency and severity of poisonings resulting from ingesting antifreeze with or without bittering agents (added to discourage ingestion).

- About 2/3 of the college participants mistook the containers of different-coloured lamp oil for beverages, and about ¼ mistook the two containers of furniture polish for either a beverage or mouthwash. Both are hydrocarbon petroleum distillate products (similar to mineral spirits, lighter fluid, and paint thinner) that are most injurious when aspirated into the lungs. Ingestion is most likely when the container is accessible and the child-resistant top has not been securely refastened, or, in the case of products like kerosene or lamp oil, when the fuel has been transferred to an alternative container like a soda bottle or a lamp. A recent study of hydrocarbon exposure in children under 5 years of age found that of the approximately 100,000 hydrocarbon calls or emergency room visits documented from 2000 – 2009, the most common circumstance was a male child, 1 or 2 years of age, at home, with an outcome that did not require

hospitalization (Jolliff, Fletcher, Roberts, Baker, and McKenzie, 2013). The most common route of exposure was ingestion, and other routes included ocular, dermal, and inhalation/aspiration. The authors noted that hydrocarbons remain in the top 10 causes of U.S. paediatric poisoning deaths, with lamp oil in the group of hydrocarbon products that is most likely to result in hospitalization. A review of 50 recent lamp oil exposure calls to five U.S. poison centres likewise found that ingestions usually occurred with children under 2, at home, not alone, when the product was on a shelf or table, and when the fuel was that used for a tiki torch (Sheikh, Chang, Kieszak, Law, Bennett, Ernst, Bond, Spiller, Schurz-Rogers, Chu, Bronstein, and Schier, 2013) [interestingly, others have noted that this fuel often resembles apple juice (cf. http://tinyurl.com/npkkhd3)]. In many non-Western countries kerosene, which is used for in-home cooking, heating, and lighting, is the most common source of paediatric hydrocarbon ingestion (Kohli et al., 2008; Nagi and Abdulallah, 1995; Siddiqui, Razzak, Naz, and Khan, 2008; Singh, Prasad, and Gaurav, 2009). According to Brown (2012), accidental poisonings tend to be more serious in developing countries because of the wider use of home fuels like kerosene. In the U.S., regulations require these products to have child-resistant packaging, and in the European Union, lamp oil and similar fuels are required to be packaged in black opaque containers to reduce the product's attractiveness to children.

- Cleaning products, commonly found in households of developed countries and often stored in insecure and child-accessible locations (Sawalha, 2007), accounted for the third largest number of paediatric exposure calls to poison control centres in the U.S. during the last two years (Bronstein et al., 2012; Mowry et al., 2013). Furthermore, over 267,000 children under 5 were seen in U.S. emergency rooms from 1990-2006 due to accidental exposure to household cleaning products, with ingestion accounting for 63% of the exposures (McKenzie, Ahir, Stolz, and Nelson, 2010). We found that college students frequently confused two all-purpose cleaners and the orange stain and odor remover with beverages. The bright colours of the blue and green cleaners portrayed in the product images and the clear, drink-like appearance of their containers are reminiscent of sports drinks and fruit juice, and were mistaken as such by young adults. It is apparent that some of the college participants did not notice the mop and bucket graphic on the all-purpose cleaners and responded, instead, in a way that was consistent with the larger images of a rainbow and/or fruit on the package. For the stain and odor remover, the shape and orange colour of the opaque container, combined with the graphic of an orange slice and rays of sunlight, likely contributed to the mistaken impression of a container of orange juice. These findings provide additional support for the idea that products with perceptual qualities (colour, style of container, graphics)

associated with foods and drinks can be mistaken for actual products intended for consumption (SCCS, 2011).

Recommendations. We would like to make the following recommendations based on our results:

- A product's appearance and packaging will influence how people understand its use. Some non-food household products are packaged in a confusing or ambiguous manner relative to their function, perhaps to take advantage of the market appeal of better-established or more positively-valenced products. For instance, packaging a brightly coloured household cleaner in a clear bottle whose label is dominated by images of fruit may encourage the familiar associations people have with fruit drinks, as well as enhance the product's general attractiveness to purchasers. Unfortunately, such marketing choices might also encourage individuals to treat an unfamiliar toxic product as something familiar and edible. Experimental research suggests that when there is a discrepancy between the messages conveyed by graphics and text in a label, the graphical information tends to dominate, perhaps due to its greater vividness or salience (Bone and France, 2001). Interestingly, recent fMRI research by Basso, Robert-Demontrond, Hayek, Anton, Nazarian, Roth, and Oullier (2014) demonstrated that a retail shower gel product containing visual imagery of oranges, a juice-like

container shape, and a push-pull sports-drink cap elicited implicit gustatory responses in expected brain regions, even when the product was correctly identified and categorized later by the participants. At a minimum, it seems likely that using an opaque container with less colourful graphics would appear to be appropriate for products not intended for ingestion.

- As noted in the SCCS (2011) report, non-edible products with a bright colour can sometimes be confused with foodstuffs. We found several instances of blurred identities across categories possibly related to product colour, such as car care items confused with household cleaners, candies mistaken for laundry packets, and cleaners mistaken for sports drinks. Colours such as blue and green, once used mainly in non-consumable products, now commonly appear in beverages such as energy drinks and fruit drinks, making it difficult to determine a product's use based on its colour. Perhaps worrisome non-edible items could benefit from either a change to a less-appealing product colour or opaque packaging that disguises the product's colour. This suggestion parallels recent research in the domain of smoking indicating that plain packaging of cigarettes is less attractive, attention grabbing, and appealing than regular (branded) packaging (Gallopel-Morvan, Moodie, Hammond, Eker, Beguinot, and Martinet, 2012; Wakefield, Hayes, Durkin, and Borland, 2013). Although this suggestion raises issues of tradeoffs between product appeal, marketability, and product safety, it seems unacceptable that the colourful and child-appealing packaging qualities

commonly used with products such as candy, foods, and children's toys also be used with toxic chemical products.

- Future studies should systematically explore the role of attributes such as product colour, label design, graphics, and shape of the package in misidentifications by vulnerable populations, a suggestion initially made by Schneider in 1977. Experimenter-created stimuli that differ systematically in attributes like container shape, opacity, or product colour, paired with measurement of behavioural responses such as choice, classification, and ranking, would provide insight into product attributes that draw attention or are perceived as more food-like. For instance, Luo, Fu, and Korvenmaa (2012) presented drawings of 60 different beverage bottle designs to consumers who were asked to classify the bottles into six unlabelled categories based on their visual similarity. The results revealed which bottle designs were perceived by viewers as being most strongly associated with the original category of the product (e.g., which bottle designs best represented the category of sports drink or fruit juice). Experimental research could also draw upon methodologies such as psychophysical scaling (Moskowitz, 2005) or perceptual matching (Luo et al., 2012) to evaluate how consumers' perception is shaped by systematic variations in product attributes.
- It would be informative to explore how the behaviour of individuals is influenced by the context in which a product appears. Accidental exposures often occur

when a product has not been stored in its usual place because it was just purchased, currently in use, or recently in use (Ozanne-Smith, Day, Parsons, Tibballs, and Dobbin, 2001) – circumstances that parallel the out-of-context presentation format of the current study. For instance, comparison of responses to a household cleaner presented in its appropriate storage context (e.g., on a shelf in a utility cabinet) or out-of-context (e.g., on a kitchen countertop, alone or next to a glass) would help to determine the extent to which product misidentification is influenced by the surroundings in which the product is embedded.

- Developmental studies would appear to be critical in this area – the kinds of indiscriminate, normal, hand-to-mouth behaviours displayed by infants and toddlers and the wide-ranging exploratory behaviours displayed by preschoolers provide many opportunities for unwanted exposure to chemical products that may be predictable, in part, by age-related behavioural differences. For example, when attempting to identify a beverage with a colour that is incongruent with its flavour (e.g., a red beverage with a chocolate flavour), young children are more influenced by colour and less influenced by flavour than are older children and adults (Oram, Laing, Hutchinson, Owen, Rose, Freeman, and Newell, 1995). Similarly, research on young children's understanding of novel objects suggests that youngsters often rely on an object's shape to make inferences about its unseen properties (Florian, 1994; Graham, Kilbreath, and Welder, 2004), which

could cause difficulties if the novel object is an unfamiliar chemical household product with packaging that resembles a fruit drink or candy.

In conclusion, knowledge of the potential toxicity of common household products, vigilance during the use of these products, and implementation of poison-proofing behaviours such as putting away products after using them and securing them out-of-sight in inaccessible cabinets, are all crucial in minimizing accidental ingestions and exposures. The first line of defence is no doubt prevention of access, and caregivers have been greatly assisted in this task in recent decades by regulators who have insisted on, and manufacturers who have created, less toxic product formulations and helpful technological safety features such as child-resistant caps and blister packs. Nevertheless, more assistance is needed in the area of product design and packaging. In addition to making toxic products less accessible, making them less appealing and less food-like may help reduce their attractiveness and confusion with edible products and, potentially, their misuse by vulnerable populations.

Limitations. Although the findings reported in these experiments were replicated and the internal validity high, there are nevertheless several caveats and limitations that should be noted:

- The external validity of a computer-based study with college students is limited. Replication with additional subject populations (e.g., young children, low-literate

adults, elderly adults), tested in different settings (e.g., at home) and with different tasks (e.g., handling items), would improve generalization.

- Although misperception of non-consumable products was demonstrated, this does not mean that individuals will necessarily engage in inappropriate behaviors such as accidental inhalation, application to skin, or ingestion of the product. Our findings directly relate only to conscious judgments about product use; they do not indicate how individuals might act upon that understanding.
- Misidentifications and miscategorizations were tied to product images, not actual products, and visual appearance is only one aspect of a product's identity. It is possible that additional information potentially available in a real product (e.g., smell, texture, taste) would work to minimize the likelihood of its misidentification and potential misuse, particularly by more experienced individuals. Also, the images in our study depict a product from the visual perspective selected by the retailer to advertise the product. It is possible that the online image does not faithfully depict the product or that the product, if portrayed from a different angle, might be perceived differently.
- One should not equate adults' mistaken identification of products with the attractiveness of the products to children. Whether children interpret ambiguous items in the same way that adults do, whether they find such items more appealing, and whether they would actually be more likely to act accordingly, are empirical questions that cannot be answered from experiments

with adults or retrospective medical case reports. For instance, we did not find evidence that college students were significantly likely to misidentify examples of single-load laundry detergent packets, yet medical researchers have speculated that the appearance of these products may contribute to their relatively high rate of accidental ingestion by children (Bonney, Mazor, & Goldman, 2013).

- We used an arbitrary criterion to determine how an individual product was identified or categorized: It had to be accurately responded to by significantly fewer than 90% of the participants in order to be flagged as incorrectly perceived. This criterion, although reasonable from a statistical point of view, may underestimate the practical consequences of a product's potentially misleading appearance. For instance, in Experiment 3, neither the lemon all-purpose cleaner nor the laundry detergent packets emerged as worrisome items because they were accurately categorized by 82% or 87% of the sample, values that were not significantly different from 90%. Nevertheless, 8 and 5 college students, respectively, considered these products to be edible.

Summary. College students identified and categorized retail products such as household cleaners, detergents, and drinks with either a subjectively ambiguous or normal appearance. Each image had been altered by removing all writing from the product packaging in order to approximate how members of a vulnerable population (e.g., young non-reading children, developmentally-disabled individuals, elderly individuals with vision

impairment) might experience the item. Also, the manner in which the items were presented (allowing a 1- or 3-second viewing time) attempted to approximate the experience of an individual who is impulsive, distracted, multitasking, or not particularly studying an item carefully. In each of three studies, non-edible products with an ambiguous appearance tended to be mistaken for edible products. Also, participants tended to respond slowly and with low confidence to the ambiguous items, suggesting a degree of confusion about their incongruent appearance and intended use. There is ample evidence to support the notion that educated adults can misperceive the function of a household product with a potentially misleading appearance when all writing has been removed from the product's container and the viewer's decision is based only on the product's appearance.

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Supplement for "Misidentification of Non-Edible Household Products"

This electronic supplement accompanies the manuscript, "Misidentification of Non-Edible Household Products," by Michael M. Marcell and Aubrey Isaacson (Issue 28, 2015). The supplement provides additional details about stimuli and data analysis aspects of this research project. The items included in this supplement are referred to in the body of the manuscript in italics with the word "supplementary" (e.g., *Supplementary Table 1*) and are listed below:

- ***Supplementary Table 1.*** Ambiguous and Normal Product Images Used in Study 1
- ***Supplementary Table 2:*** Probability That an Ambiguous Stimulus Was Identified at 90% Accuracy (Study 1)
- ***Supplementary Table 3.*** Ambiguous and Normal Product Images Used in Studies 2 and 3
- ***Supplementary Table 4:*** Probability That an Ambiguous Stimulus Was Identified at 90% Accuracy (Study 2)
- ***Counterbalancing Supplement:*** Description of Response Alternative Counterbalancing (Study 3)
- ***Supplementary Table 5.*** Probability That an Ambiguous Stimulus Was Categorized at 90% Accuracy (Study 3)
- ***Supplementary References***

Supplementary Table 1. Ambiguous and Normal Product Images Used in Study 1

Type of Stimulus [a]			
Ambiguous [b]		**Normal** [c]	
Mothballs (multicoloured)			Crème mint candies
All-purpose cleaners			Sports drinks
Antifreeze			Tropical punch
Adhesive			Toothpaste
Insecticide spray			Air freshener spray
Laundry detergent packets			Wrapped mint candies

Note. All visible writing on the product was removed so that identification would be based on product appearance alone. Photos obtained via Google Images search, Fall, 2012.

Supplementary Table 1 *(continued)*

[a] In addition to the six Ambiguous and six Normal stimuli listed in the table, a third type of stimulus was presented but not included in the analyses. The eight Filler stimuli (cereal, rat poison, bar soap, spray cleaner, corn chips, gelatine dessert, tomato sauce, and ice cream) were used as distractor items to increase the number of product images of different types.

[b] Four of the Ambiguous stimuli were selected because of their potential confusion with products that are meant to be ingested. The other two Ambiguous stimuli – adhesive and insecticide spray – were selected because of their potential confusion with products meant to be used for brushing teeth or freshening air, respectively.

[c] Normal product images were selected to be similar in appearance to the Ambiguous product in the same row.

Supplementary Table 2. Probability That an Ambiguous Stimulus Was Identified at 90% Accuracy (Exp.1, *n* = 22)

Ambiguous Stimulus	Number of Correct/Incorrect Responses	Percent Correct	Cumulative Binomial Probability
Multicoloured mothballs	0/22	0.0%	.000000000001*
All-purpose cleaners	5/17	22.7%	.000000000001*
Antifreeze	7/15	31.8%	.000000000086*
Adhesive	0/22	0.0%	.000000000001*
Insecticide spray	6/16	27.3%	.000000000004*
Laundry detergent packets	16/6	72.7%	.0182

Note. An exact binomial test was applied to each stimulus in order to assess the cumulative probability that X or fewer correct identifications occurred out of 22 responses. The number of correct identifications was evaluated against a criterion of .9 (90%) expected success.

* Result was significant at alpha = .008 or better (.05 alpha / 6 items).

Background and Summary for Supplementary Table 2

Background. The number of correct and incorrect responses to each Ambiguous product image was tallied for the 22 participants. An exact binomial test was applied to determine whether the number of correct identifications was significantly lower than the expected proportion of .90 correct, a lenient level set well below the 98.5% accuracy rate achieved with the set of Normal stimuli. The exact binomial test evaluated the cumulative probability of achieving X or fewer correct identifications. The cumulative probability required for significance was set at .008 or less (alpha = .05 / 6) in order to reduce the likelihood of making a Type 1 error. A binomial test was used because the small sample size (*n* = 22) and the expected proportions of .90 correct and .10 incorrect identifications would have resulted in a violation of the chi square assumption that no cell have an expected frequency < 5. *[This was not an issue in Studies 2 and 3 where the sample sizes were 69 and 77, respectively, and each cell's expected frequency was > 5.]*

Background and Summary for Supplementary Table 2 *(continued)*

Summary. Five of the six Ambiguous stimuli were unsuccessfully identified and are described in the manuscript. Although the sixth stimulus (laundry detergent packets) was successfully identified by only 72.7% of the participants, this value was not significantly lower than the 90% criterion. It is interesting to note that the six college students who misidentified laundry detergent packets indeed perceived them to be edible objects [either candy (*n* = 5) or throat lozenges (*n* = 1)], and that reports of accidental ingestion or eye injury (from biting into liquid detergent packets) of single-use, concentrated detergent packets by children continue to appear (Beuhler, Gala, Wolfe, Meaney, and Henretig, 2013; Forrester, 2013; Huntington, Heppner, Vohra, Mallios, and Geller, 2014).

Supplementary Table 3. Ambiguous and Normal Product Images Used in Studies 2 and 3

Type of Stimulus [a]			
Ambiguous [b]		**Normal** [c]	
Apple shower gel			Apple juice
Lavender floor cleaner			Grape juice
Berries air freshener crystals			Dried fruit
Laundry detergent packets			Wrapped mints
Insecticide spray			Bathroom cleaner spray
All-purpose cleaner (blue)			Raspberry fruit drink

All-purpose cleaner (green)			Berry fruit drink
Cinnamon-raspberry furniture polish			Cold and flu medicine
Rose fragrance insecticide spray			Blossom air freshener spray
Windshield washer			Raspberry drink
Lamp oils			Fruit juices
Mothballs (white)			Mints
Mothballs (multicoloured)			Candy

Lemon all-purpose cleaner			Corn oil
Lemon garbage disposer deodorizer			Lemon drops
Orange all-purpose cleaner			Orange soda
Orange stain and odour remover			Orange juice
Strawberry cocktail shower gel			Barbeque sauce
Antifreeze			Raspberry snow cone syrup
Lemon oil furniture polish			Vodka

Supplementary Table 3 *(continued)*

Note. All visible writing on the product was removed so that identification would be based on a product's appearance alone. Photos obtained via Google Images search, Spring, 2013.

[a] In addition to the 20 Ambiguous and 20 Normal stimuli listed in the table, a third type of stimulus was presented but not included in the analyses. The 20 Filler stimuli (bleach, cereal, corn chips, cookies, bar deodorant, dishwashing soap, glass cleaner, ice cream, gelatine dessert, liquid laundry detergent, motor oil, mouthwash, nail polish, house paint, rat poison, bar soap, spray cleaner, toilet bowl cleaner, tomato sauce, and weed killer) were used as distractor items to increase the number of product images of different types.

[b] Eighteen of the Ambiguous product images were selected because of their potential confusion with products that are meant to be ingested. The other two Ambiguous products – the two insecticide sprays – were selected because of their potential confusion with products meant to be used for cleaning bathrooms or freshening air.

[c] Normal product images were selected to be similar in appearance to the Ambiguous product in the same row.

Supplementary Table 4. Probability That an Ambiguous Stimulus Was Identified at 90% Accuracy (Exp. 2, *n* = 69)

Ambiguous Stimulus	**Number Correct / Incorrect Responses**	**Percent Correct**	**Chi Square (*df* = 1)**	***p***
Apple shower gel	63/6	91.3%	0.130	= .7180
Lavender floor cleaner	39/30	56.5%	85.928	< .0001*
Berries air freshener crystals	8/61	11.6%	471.306	< .0001*
Laundry detergent packets	61/8	88.4%	0.195	= .6589
Insecticide spray	6/63	8.7%	506.797	< .0001*
All-purpose cleaner (blue)	37/32	53.6%	101.451	< .0001*
All-purpose cleaner (green)	19/50	27.5%	299.132	< .0001*
Cinnamon-raspberry furniture polish	13/56	18.8%	388.214	< .0001*
Rose fragrance insecticide spray	5/64	7.2%	525.026	< .0001*
Windshield washer	26/43	37.7%	209.857	< .0001*
Lamp oils	0/69	0.0%	621.000	< .0001*
Mothballs (white)	9/60	13.0%	454.043	< .0001*
Mothballs (multicoloured)	0/69	0.0%	621.000	< .0001*
Lemon all-purpose cleaner	53/16	76.8%	13.335	= .0003*
Lemon garbage disposer deodorizer	44/25	63.8%	52.755	< .0001*
Orange all-purpose cleaner	58/11	84.1%	2.707	= .0999
Orange stain and odor remover	15/54	21.7%	357.232	< .0001*
Strawberry cocktail shower gel	0/69	0.0%	621.000	< .0001*
Antifreeze	15/54	21.7%	357.232	< .0001*
Lemon oil furniture polish	35/34	50.7%	118.262	< .0001*

Supplementary Table 4 *(continued)*

Note. A chi square goodness of fit test was applied to each Ambiguous stimulus to determine whether the pattern of correct and incorrect responses for the 69 participants was a "good fit" with the expected proportions of .90 correct and .10 incorrect employed in Study 1.

* Result was significant at alpha = .0025 or better (.05 alpha / 20 items).

Summary for Supplementary Table 4. 17 of 20 Ambiguous stimuli were significantly misidentified. The three items that were correctly identified (i.e., not significantly different from 90% expected accuracy) were apple shower gel, laundry detergent packets, and orange all-purpose cleaner.

For 11 of the 17 Ambiguous products that were significantly misidentified, the dominant response was indeed the one that had been anticipated and used as the basis for selecting the paired Normal product (e.g., 81% of the individuals who misidentified the image of lemon all-purpose cleaner mistook it for cooking oil).

The six exceptions were as follows: a) Cinnamon-raspberry furniture polish was misidentified as "cherry cough syrup" by only one participant and as mouthwash by four others. The two most common types of incorrect responses were, instead, a type of beverage (e.g., "cherry juice") or liquid fragrance (e.g. "candle scent refill"); b) Windshield washer was mistaken for a beverage by only one participant, with all other misidentifications indicating confusion with cleaning products (e.g., "bleach," "floor cleaner," "laundry detergent"); c) Responses to the lemon garbage disposer deodorizer were roughly equally divided between edible (e.g., "lemon candy") and non-edible (e.g., "dish washer detergent") misidentifications; d) Although mistaken for a tomato-based sauce by only two participants, strawberry cocktail shower gel was nevertheless seen as an edible but alcohol-related product by most other participants (e.g., "bloody Mary mix," "margarita mix," "cocktail mixer"); e) Antifreeze was typically seen as a type of household cleaning product rather than a car care product, with only two participants confusing it with something to drink; f) Lemon oil furniture polish was mistaken for a variety of items, most often a cleaning product (e.g., "dish soap") or an alcohol-related product (e.g., "flavoured vodka"), but also a juice-type beverage (e.g., "lemon juice") or mouthwash (e.g., "Listerine").

It is important to note that although nearly all stimuli in the Normal set were identified at high levels of accuracy, three actually elicited responses indicating confusion across product categories. One Normal stimulus (cold and flu medicine) was thought to be something to drink (typically "juice") by 11 participants; given this outcome, it would have been reasonable to place this product in the set of Ambiguous stimuli. Wrapped blue mint candies were mistaken by 24 participants for inedible products (typically dishwasher or laundry detergent packets), a lower rate of identification than was seen with the paired Ambiguous item (actual laundry detergent packets). Finally, 67 of 69 participants believed that the container of blue-raspberry syrup (likely an unfamiliar product for many) represented an inedible item like a household cleaner or car care product. As noted in the SCCS report, bright colours such as blue and green that were once reserved for liquid cleaning supplies and other toxic products are now used frequently in products such as sports and energy drinks, making it difficult to determine what a product is used for when its visible colour no longer uniquely indicates its function (SCCS, 2011).

Counterbalancing Supplement. Description of Counterbalancing of Response Alternative in Study 3

The four multiple-choice response alternatives for each to-be-categorized stimulus always appeared in the same fixed order across the 60 trials for a given participant. However, the particular fixed order that a participant experienced was determined randomly using Latin Square (incomplete) counterbalancing.

Latin Square counterbalancing was used to generate the four most representative orderings of response alternatives out of 4! (24) possible orders. The four response alternatives were Personal Consumption (PC), Personal Hygiene (PH), Household Chores (HC), and Outside Chores or Pest Control (OP). Each participant was randomly assigned to a response screen that positioned the response alternatives in one of the following ways (with the order of listing below referring to the screen positions of upper left, lower left, upper right, and lower right):

PC - PH - OP – HC

PH - HC - PC – OP

HC - OP - PH – PC

OP - PC - HC – PH

Because each response alternative appears in each position the same number of times and is both preceded and followed the same number of times by each other response alternative, the use of these four orders provided excellent control for potential sequence confounds related to the positioning of response alternatives on the screen.

Supplementary Table 5. Probability That an Ambiguous Stimulus Was Categorized at 90% Accuracy (Exp. 3, *n* = 77)

Ambiguous Stimulus	**Number Correct / Incorrect Responses**	**Percent Correct**	**Chi Square (*df* = 1)**	***p***
Apple shower gel	66/11	85.7%	1.571	= .2100
Lavender floor cleaner	64/13	83.1%	4.053	= .0441
Berries air freshener crystals	9/68	11.7%	524.688	< .0001*
Laundry detergent packets	67/10	87.0%	0.763	= .3823
Insecticide spray	12/65	15.6%	473.779	< .0001*
All-purpose cleaner (blue)	52/25	67.5%	43.188	< .0001*
All-purpose cleaner (green)	43/34	55.8%	99.811	< .0001*
Cinnamon-raspberry furniture polish	45/32	58.4%	85.208	< .0001*
Rose fragrance insecticide spray	3/74	3.9%	634.299	< .0001*
Windshield washer	28/49	36.4%	246.131	< .0001*
Lamp oils	29/48	37.7%	234.356	< .0001*
Mothballs (white)	23/54	29.9%	309.335	< .0001*
Mothballs (multicoloured)	1/76	1.3%	673.144	< .0001*
Lemon all-purpose cleaner	63/14	81.8%	5.727	= .0167
Lemon garbage disposer deodorizer	65/12	84.4%	2.668	= .1024
Orange all-purpose cleaner	69/8	89.6%	0.013	= .9093
Orange stain and odour remover	39/38	50.6%	132.481	< .0001*
Strawberry cocktail shower gel	0/77	0.0%	693.000	< .0001*
Antifreeze	33/44	42.9%	190.143	< .0001*
Lemon oil furniture polish	54/23	70.1%	33.779	< .0001*

Supplementary Table 5 *(continued)*

Note. A chi square goodness of fit test was applied to each Ambiguous stimulus to determine whether the pattern of correct and incorrect responses for the 77 participants was a "good fit" with the expected proportions of .90 correct and .10 incorrect employed in Study 1.

* Result was significant at alpha = .0025 or better (.05 alpha / 20 items).

Summary for Supplementary Table 5. The outcomes of these analyses indicated that 14 of the 20 Ambiguous stimuli were significantly miscategorized. In Study 3, green all-purpose cleaner, cinnamon-raspberry furniture polish, lamp oils, orange stain and odour remover, antifreeze, and lemon oil furniture polish were categorized more accurately than they were identified in Study 2, showing a 20% or better improvement in recognition. Nevertheless, they were categorized significantly below the 90% accuracy criterion.

Of the six stimuli that were not significantly miscategorized, three had also been correctly identified in Study 2 (apple shower gel, laundry detergent packets, and orange all-purpose cleaner). The three that had been significantly misidentified in Study 2 at an average accuracy of 65.7% – lavender floor cleaner, lemon all-purpose cleaner, and lemon garbage disposer deodorizer – were categorized at an average accuracy of 83.1% in Study 3. The pattern of errors for the latter three items across the two studies suggests that the simplified response and scoring procedure of placing items into predetermined general categories resulted in a more sensitive and appropriate measure of knowledge of product use than generating typed identifications.

Although stimuli in the Normal set were once again identified at high levels of accuracy, three items elicited responses indicating confusion across product categories. The wrapped blue mint candies item was again confused with inedible products (28 of 77 participants placed the item in the Household Chores category), paralleling the tendency of some participants in Study 2 to misidentify the item as detergent packets. All but one of 77 participants placed the container of blue-raspberry syrup in either the Outside Chores and Pest Control category (52 responses) or Household Chores category (24 responses), echoing the tendency of participants in Study 2 to misidentify the stimulus as a car care product or a household cleaner. The third Normal product miscategorized by Study 3 participants was the bag of white mints, which was placed into the Household Chores category by 18 individuals (paralleling a smaller subset of Study 2 participants who identified the item as detergent tablets).

Finally, a Normal item that was misidentified in Study 2, but largely accurately categorized in Study 3, illustrates the tradeoffs encountered when weighing one response procedure over another. In Study 2, 11 participants misidentified cold and flu medicine as juice; in Study 3, however, this type of confusion was not apparent because both "drinking" and "taking medicine" responses were included as examples of product use in the same Personal Consumption category. Thus, although employing a broad edible products category (Personal Consumption) simplified the participant's classification task, it did so at the expense of losing the distinction between drinking juice and taking medicine. Because the cold and flu stimulus was the only medicine product in the set of 60 stimuli, rather than create a response category with only one member, the decision was made to broaden the scope of the Personal Consumption category to include "taking medicine" in addition to eating and drinking. The same decision was made in relation to the corn oil stimulus – it was the only item related to cooking or preparing food and was thus included in the Personal Consumption category.

Supplementary References (*Note: This section incorporates only references used in this supplement.)*

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