Misidentification of Non-Edible Household Products

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Abstract

College students identified and categorized pictures of retail products such as household cleaners, detergents, and drinks with either an ambiguous or normal appearance. Each image had been altered by removing all writing from the 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 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 that were similar in appearance. Furthermore, 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.

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. 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). 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, 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 168 U.S. college students (72.6% female, 27.4% male; median age = 20 years) with normal or corrected-to-normal visual acuity. 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).

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. Twenty images of retail products such as foods, drinks, personal hygiene items, household cleaning products, and lawn care items 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** on the next page for examples of altered product images).

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. After identifying an image, participants were asked to indicate how confident they were in the identification by using a 1 ("Not at all confident")

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.

to 7 ("Highly confident") 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** on the next page contains a sequence of screenshots illustrating a typical product image identification trial.

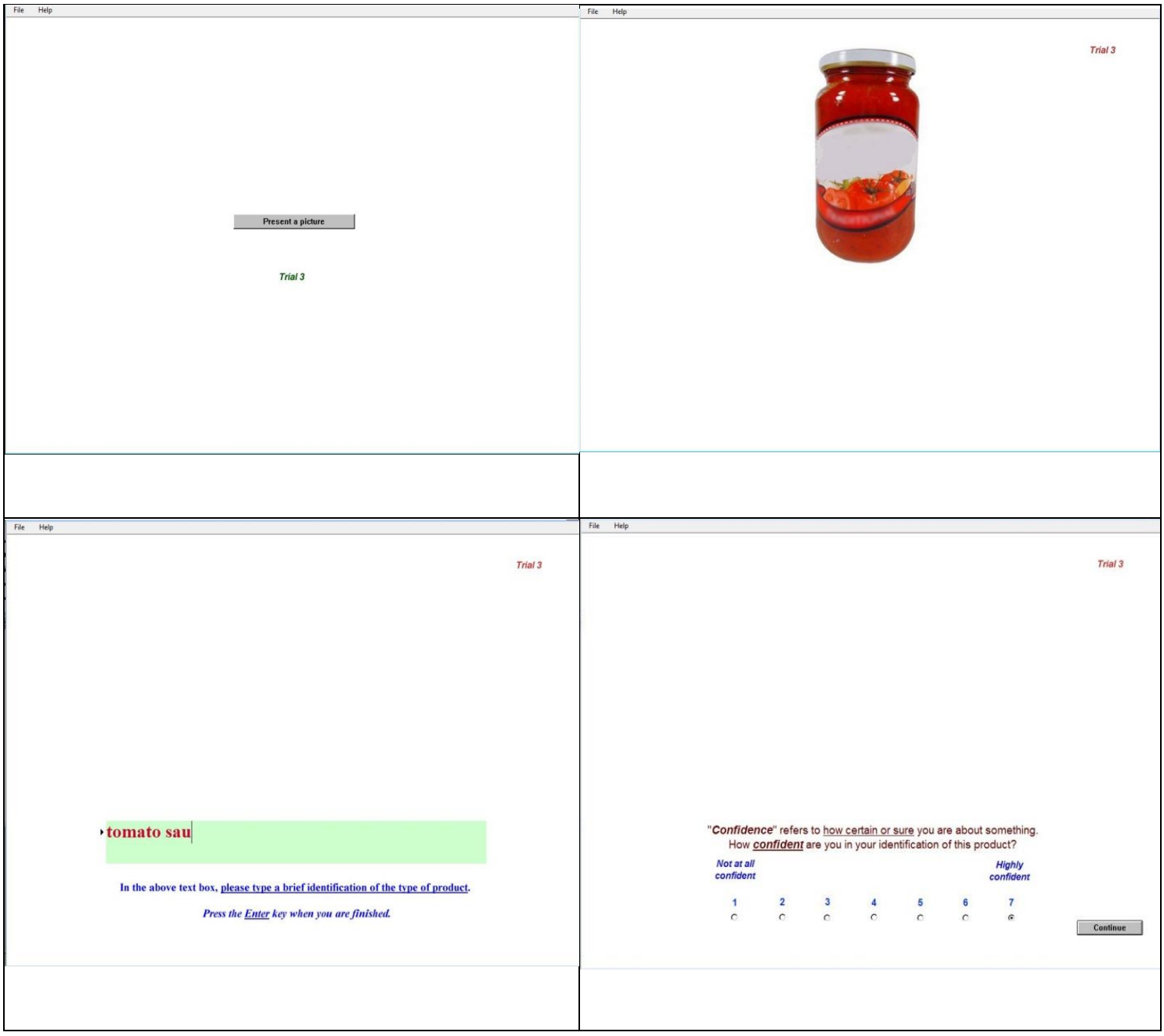

Figure 2. Sequence of screenshots from Study 1 created in Macromedia Authorware: *(Upper Left)* When participant clicks the button, a stimulus is presented; *(Upper Right)* The stimulus (tomato sauce, a product from the Filler Stimulus category) is presented for 1 second; *(Lower Left)* A textbox then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

The results indicated that participants correctly identified significantly fewer items from the Ambiguous than the Normal set of stimuli. Five of the six Ambiguous stimuli were unsuccessfully identified: 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 typical incorrect response to insecticide spray was, as expected, air freshener, the remaining 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 rather than fruit punch. 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 set for successful identification (it is interesting to note that the six college students who misidentified laundry detergent packets indeed perceived them to be edible objects, either candy or throat lozenges). Results also indicated that participants were less confident and slower in their identifications of Ambiguous than Normal stimuli.

To summarize, Study 1 indicated that briefly-presented pictures of non-consumable products without text were frequently mistaken by college students for products that could be ingested. 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 (*n* = 69), number of stimuli (60), experimental design, and procedural details to provide a stronger empirical test of the notion that consumer products with a misleading appearance will be inaccurately identified. For instance, during the previous study a product image was exposed for 1 second. Although this duration was clearly sufficient for near-perfect Normal product identification, 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). Thus, in Study 2, half of the participants were allowed triple the amount of time to view the stimuli.

The primary research questions 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?

20 new product images were placed into each of the three product categories (Ambiguous, Normal, or Filler) and were modified as before to remove all text (see **Figure 3** on the next page for examples). All testing procedures were identical to Study 1, with the

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.

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, thus reducing the memory demand on the participant (see **Figure 4** on the next page for a screenshot from a typical trial).

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 results indicated that non-edible products with a confusing appearance tended to be mistaken for similar-looking edible products, a strong replication of the results of Study 1 with an expanded set of stimuli. Follow-up analyses indicated that 17 of the 20 Ambiguous stimuli were significantly misidentified (e.g., 81% of the individuals who

misidentified the image of lemon all-purpose cleaner mistook it for cooking oil). Although participants in the 3s group tended to be about a half item more accurate in their identification of products, this pattern was no different for Ambiguous and Normal stimuli. Analyses also revealed that participants were less confident and slower in their identifications of Ambiguous products, suggesting that participants experienced hesitancy and uncertainty when attempting to identify these products by their appearance alone.

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?

In Study 3 (n = 77) we assessed 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

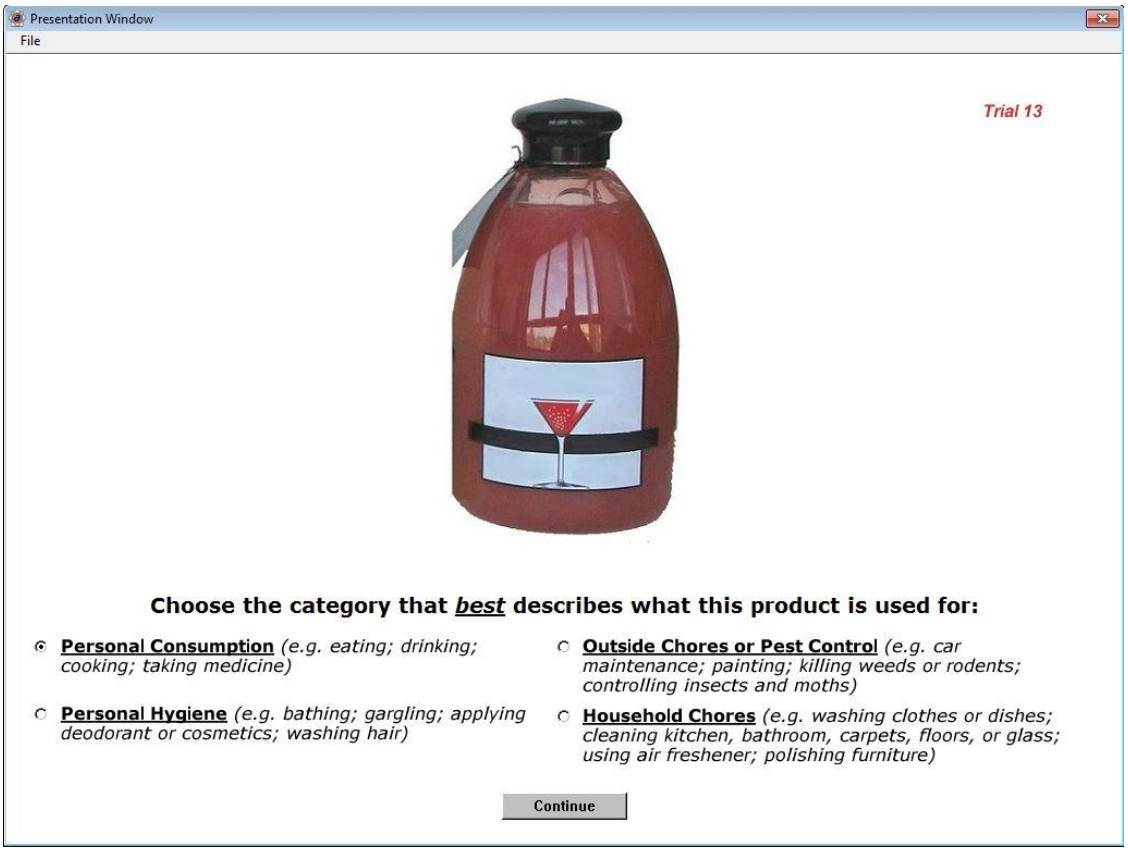

Figure 5. Screenshot from Study 3 created in Macromedia Authorware. Strawberry cocktail shower gel (a product from the Ambiguous Stimulus category) is displayed simultaneously with a multiple-choice question requiring the participant to categorize the use of the product. The order in which the categories 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.*

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"). **Figure 5** above shows the four response categories as they appeared on a typical trial; the

participant's goal on each trial was to select the single category that best described what the product is used for. The 60 stimuli were unchanged from Study 2.

The major research questions 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?

Analyses indicated that the set of Ambiguous products was categorized significantly less accurately than the set of Normal products, and follow-up analyses suggested that this pattern was characteristic of 14 of the 20 Ambiguous stimuli. 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, suggesting 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. As before, participants were less confident and slower in their category placement of Ambiguous than Normal products. In summary, when writing

was removed from pictures of non-edible products with a confusing appearance, there was a strong tendency to inaccurately categorize their use.

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 their 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 ("personal consumption"). It seems reasonable to hypothesize 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 a product's warning label 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.

Table 1 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 items in this table to be worrisome items, products whose misidentification and miscategorization would directly and negatively impact physical health if acted upon (e.g., deciding that lamp oil or a household cleaner could be consumed as a sports drink). 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).

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.

Recommendations. We would like to make a few 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 appropriately-shaped container with less colourful graphics would create a less confusing appearance for products not meant to be ingested.

- 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).

- 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.

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.

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