Social Referencing “Mr. Yuk”: The Use of Emotion in a Poison Prevention Program

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Objective To assess whether disgust, the emotion depicted on poison control “Mr. Yuk” stickers, conveys an age-appropriate message to young children. Methods Two preliminary studies (both N = 48) were conducted with adults to assess what facial expressions of emotion they associated with child and adult violations of precautionary rules. Subsequently, 20 3-year-olds and 35 4-year-olds were tested on age-appropriate scenarios to determine what facial expressions of emotion they associate with accidental poisonings. Results Adults associated violations of precautionary rules, regardless of whether they involved children or adults and physical injury or accidental poisonings, with facial expressions of fear, not disgust. The study conducted with children indicated that they likewise anticipated facial expressions of fear in response to accidental poisonings. Conclusions The disgust displayed on Mr. Yuk stickers does not appear to convey a valid emotional message, regardless of whether the stickers are used for preventive or educational purposes.

Key words accidents and injuries; children; disgust; facial expression of emotion; fear; Mr Yuk; prevention control; social referencing.
handled containers labeled with the Mr. Yuk stickers more often than non-labeled containers (Vernberg, Culver-Dickinson, & Spyker, 1982). Although few in number, other studies examining the effectiveness of the Mr. Yuk stickers have concluded that the stickers are not successful in preventing the ingestion or handling of toxins by children under the age of three (Demoset & Osterhoudt, 2002). Consequently, Mr. Yuk stickers are no longer recommended for use as a deterrent, but are instead recommended for use as a poison prevention educational tool (Dr Edward Krenzelok, Director, Pittsburg Poison Center, personal communication, June 2, 2006).

Nevertheless, numerous government agencies and poison control centers throughout the USA still advocate the use of Mr. Yuk stickers as a deterrent against accidental poisonings. For example, the Idaho Department of Health and Welfare’s (2008) 2-1-1 e-Library informs parents that:

> Your home is filled with many products that make life easier and more pleasant as long as they are not eaten or inhaled by children, things like cosmetics, cleaning supplies, and medicines. You can identify these dangerous products with Mr. Yuk stickers and teach your children that his green, scowling face means danger. Mr. Yuk can say ‘No’ for you when you are not immediately available to protect your child [similarly worded advice is also provided by the Oregon Poison Center, 2008].

The State of Washington Poison Center (2008) in addressing the question “How can I prevent poisonings?” recommends that one “Teach children about Mr. Yuk and put the stickers on poisons.” The Environmental Protection Agency (2008) provides aids for teachers with the stated objective: “To teach students to recognize the ‘Mr. Yuk’ symbol; to help students understand that this symbol designates hazardous household products that should not be handled without adult supervision and without reading labels properly.” Hence, despite evidence suggesting that Mr. Yuk stickers are ineffective as deterrents, they are still routinely advocated for this purpose.

**Social Referencing: Is Disgust the Appropriate Emotion?**

Social referencing refers to the phenomenon, whereby infants use adults’ emotional reactions to form their own interpretation of events (Feinman, 1982). For example, Sorce, Emde, Campos, and Klinnert (1983) have observed that 12-month-old infants will use a parent’s fear expression to decide whether or not to crawl over an ambiguous visual cliff. While the message communicated by Mr. Yuk stickers might solely be one of arbitrary association (Mr. Yuk = “stay away”), we believe that the clear display of a prototypical disgust reaction is more likely to prompt social referencing by young children.

Negative emotional information, such as a disgust reaction, is particularly prone to influencing infants’ behavior through social referencing (Vaish, Grossman, & Woodward, 2008). Rather than simply interpreting Mr. Yuk stickers as a signal to “stay away,” Mr. Yuk likely conveys the more intuitive and meaningful message that the contents of the containers on which he is placed are disgusting. Indeed, this is the message promoted by the National Institute of Environmental Health Science (2008) on their Kids’ Pages: “How does he [Mr. Yuk] do his job? Well, when you eat something bad, have you ever made a face like Mr. Yuk’s? If so, then you can see why his ‘yukky’ face will remind you to be careful not to touch, eat, or drink things that will make you sick!” However, it is an open question as to whether or not children associate disgust with poisonous substances or danger. It is possible that children associate a different emotion, for example, fear or anger, with danger and poisons more than they associate disgust. In these instances, it could render Mr. Yuk stickers less effective and/or ineffective.

The Mr. Yuk program is, in essence, a fear appeal directed at young children. Fear appeals are messages designed to scare or frighten people into a course of action. They are widely employed in public service announcements promoting public health and safety. In a meta-analysis of over 100 empirical studies of health and safety fear appeals, Witte and Allen (2000) observed that induced fear has a significant effect on health protective attitudes, intentions, and behaviors. Fear appeals often invoke a range of emotions (Dillard, Plotnick, Godbold, Freimuth, & Edgar, 1996), typically combining fear-eliciting and disgust-eliciting materials, e.g., verbal messages about the risks of lung cancer associated with smoking along with images of cancerous tissue (Nabi, 1998). Likewise, the Mr. Yuk program can be viewed as pairing a fear-eliciting message with a disgust-eliciting image. This is potentially confusing, even for adults, as different emotions are associated with different domains of action (Dillard, 1994; Fiddick, 2004; Rozin, Lowery, Imada, & Haidt, 1999) making it imperative to select an outwardly unambiguous emotional signal for messages communicated about a specific domain of action.

Accidental poisonings can be interpreted as falling within the prudential domain of hazard management. Fiddick (2004) has shown that different emotional reactions are associated with violations of precautionary rules.
If the hazard exists, then you must protect yourself)—rules regulating actions in the domain of hazard management—and violations of logically matched social contract rules (If you take the benefit, then you must pay the cost). Adults associate violations of precautions with fear and violations of social contracts with anger. This raises the possibility that young children might also associate hazardous actions, like consuming poisons, with fearful reactions. Mr. Yuk might, therefore, be expressing a less effective emotion, disgust instead of fear. If young children recognize the same differences between these emotions and the situations in which they are likely to be evoked, then it would be important that the emotion match the message. Studies of antitobacco fear appeals directed at adults suggest that their effectiveness is reduced when disgust-eliciting images are combined with fear-eliciting verbal messages (Leshner, Bolls, & Thomas, in press; Leshner, Vultee, & Bolls, 2007). Toward this end, we sought to clarify which emotions are evoked by accidental poisonings and which emotions young children expect adults to display when an accidental poisoning occurs.

Reliability and Applicability of Adult Results

The method employed in the studies reported here was adapted from Rozin et al. (1999). It involves presenting participants with descriptions of norm violations and asking them to indicate who they think saw the violation occur by selecting a face from an array of photos depicting different facial expressions of emotion. Following Fiddick (2004), we will use social contract rules as a control condition to assess for general biases to favor or avoid particular emotional responses. Likewise, we have expanded upon Rozin et al.’s method by embedding normative rules/warnings in vignettes that support the intended interpretation of the rules as precautions (If the hazard exists, then you take the protective measure) or as social contracts (If you take the benefit, then you meet the requirement). Using this expanded version of Rozin et al.’s method, Fiddick’s (2004) finding that violations of precautions are associated with fear and violations of social contracts are associated with anger has been replicated cross-culturally with British, Singaporean, Indian (Fiddick, 2007), and Japanese adults (Fiddick et al., 2009).

These studies all employed a forced-choice methodology in which participants were asked to select one face from an array of four different faces expressing the emotions anger, disgust, fear, and contempt or happiness, depending upon the particular study. A lively debate over the facial expression of contempt suggests that such a forced choice methodology might be problematic (Wagner, 2000). However, when Likert-scale ratings were alternatively employed (as in Experiments 1 and 2, presented herein), the same preference for associating violations of precautions with fear and violations of social rules with anger was observed among Australian and Singaporean adults (Bushell, 2007).

Further construct validity for the association between fear and violations of precautions is suggested by Fiddick et al. (2009) who found that the presentation of fearful faces selectively enhanced reasoning about precautionary rule violations as opposed to reasoning about social contract rule violations (which was enhanced by the presentation of angry faces). This converges with the results of an fMRI study by Fiddick, Spampinato, and Grafman (2005) in which it was observed that regions of the brain that have previously been associated with anger were active when participants reasoned about social contracts, but not when reasoning about precautions.

Despite the reliability and generalizability of the fear/precaution association, the fact remains that all of these studies have primarily assessed adults’ thoughts about the actions of other adults. Given Mr. Yuk’s hypothesized role as an adult social referencing model, it is important to first establish how adults would react to a child’s violation of a precautionary rule. It is possible that they might react differently than they would to another adult’s behavior, e.g., with anger rather than fear. Experiment 1, therefore, explores whether adults react similarly to children’s rule violations as they do to adults’ rule violations.

Given that emotional reactions to rule violations appear to be domain-specific (Fiddick, 2004; Rozin et al. 1999), it is possible that the subset of precautionary rules against poisonings might elicit different emotional reactions, i.e., disgust rather than fear. Preliminary evidence suggests that this is not likely to be the case as some of the scenarios employed by Fiddick (2004, “Poison Dart” scenario; 2007, “Tanka” scenario) involved rules against accidental poisonings, yet violations of both rules were consistently associated with fearful reactions. Nevertheless, no systematic attempt has been made to assess whether child or adult violations of precautionary rules against accidental poisonings are associated with fear rather than disgust. Experiment 2 addresses this empirical gap and, following from previous results, we predict that violations of such rules will be associated with fearful reactions, at least when adults are reacting to the actions of other adults.

Finally, after Experiments 1 and 2 have clarified how adults would react to a child’s violation of precautionary
rules and more specifically precautionary rules against accidental poisonings, we investigate, in Experiment 3, whether children in the age range that Mr. Yuk stickers target (3- and 4-year-olds) correctly anticipate the emotional reactions of adults to a child’s violation of precautionary warnings against accidental poisonings. We predict that children will also associate violations of precautionary warnings against accidental poisonings with fearful reactions instead of disgust reactions.

Experiment 1: Are Different Emotions Elicited when Children Violate Precautionary Rules?  

**Method**

Participants  
Participants were 35 females (M = 24.3 years) and 13 males (M = 27.5 years; age range of both sexes = 17–45 years, SD = 6.4 years) recruited from public places on a regional Australian university campus. The participants were primarily white, middle class students and they received a candy as compensation for their participation. Participants indicated their implicit consent by agreeing to participate after being informed of the general nature of the study. The study was approved by the host institution’s IRB.

Materials and Procedure  
Participants were tested by the second author in the locations where they were recruited, e.g., picnic tables outside the student union building. Though they completed tasks in a public setting, participants were instructed to work on their own and were monitored by the Experimenter to ensure that they complied with this instruction. Participants completed 10 variants of Rozin et al.’s (1999) emotion selection task (see above), each printed on a separate page in a paper booklet (copies of the tasks may be obtained by contacting the authors). The tasks presented participants with a short vignette that revolved around the violation of a rule, either a precaution or a social contract. The vignettes were designed to be brief, establishing existence of a hazard (precautions) or a rationed benefit (social contracts) in order to provide a context facilitating the intended interpretation of the rule. The vignettes further explained that the rule had been broken and someone else, always an adult family member, had seen this happen. The participants’ task was to rate how likely the family member observing the violation would display each of four different emotional reactions (anger, disgust, fear, and surprise) that were displayed visually using 7 cm × 5 cm black and white reproductions of Matsumoto and Ekman’s (1988)  

Japanese and Caucasian Facial Expression of Emotion slides—a standardized set of slides that have been validated cross-culturally (Biehl et al. 1997). The photos were displayed in a 2 × 2 array with the order of the emotions randomized across the scenarios within each content domain and matched across domains.

For each vignette, there was a child violator version and a child violator version. Participants received exclusively adult or exclusively child versions. The person witnessing the violation was always a spouse (adult version) or a parent (child version). There were five precautionary vignettes and five social contract vignettes. Two tasks from each domain featured Caucasian female faces, the remaining three tasks featured a set of Japanese female, Japanese male, or Caucasian male faces. The same faces were used in both the precaution and social contract tasks and both the adult and child versions of each task. Participants rated the likelihood that each emotional facial expression would be expressed on a 7-point Likert scale ranging from 1 = highly unlikely to 7 = highly likely.

Results and Discussion  
The ratings for each participant were averaged across the five precautionary tasks and the five social contract tasks and then entered into a three-way mixed MANOVA with emotion (anger, disgust, fear, and surprise) and domain (precaution vs. social contract) as within-subjects variables and violator age (adult vs. child) as a between-subjects factor. All effect sizes are reported as $r^2$, the proportion of variance accounted for (based on Wilks’ lambda or partial $\eta^2$ for the MANOVAs).

There was a significant main effect for violator age, $F(1, 46) = 4.84, p < .05, r^2 = .10$. Participants thought that the person was more likely to react with one of the four emotions to the adult violations (M = 4.4) than the child violations (M = 4.1). There were also significant main effects for domain, $F(1, 46) = 37.88, p < .001, r^2 = .45$, and emotion, $F(3, 44) = 56.54, p < .001, r^2 = .79$. However, these effects are best viewed within the context of a significant emotion × age interaction, $F(3, 44) = 4.15, p < .02, r^2 = .22$, and a significant domain × emotion interaction, $F(3, 44) = 88.30, p < .001, r^2 = .858$.

In order to explore these interactions further, four separate domain × violator age MANOVAs were conducted on each emotion separately. The results of these MANOVAs are presented in Table I. As can be seen, participants associated angry reactions with violations of social contracts more than violations of precautions. Conversely, they associated fearful reactions more with violations of precautions than violations of social
contracts—this is the same pattern of emotional reactions observed previously (Fiddick, 2004, 2007; Fiddick et al., 2009). Additionally, disgust was associated more with violations of social contracts. More importantly, it was the emotion that was least associated with precaution violations. Conversely, surprise was associated more with violations of precautions. There were also significant main effects for violator age with respect to disgust and surprise, but in both cases these emotional reactions were directed more at adults than at children. There was no significant main effect or interaction involving violator age for the fear expressions.

To summarize, violations of precautions were associated with fear, regardless of whether the violator was an adult or a child; violations of social contracts were associated with anger, regardless of whether the violator was an adult or a child. Disgust was the least likely emotion to be associated with rule violations and was associated less with child violations than adult violations. Our results of Experiment 1 suggest that adults are not likely to display disgust in reaction to a child’s violation of a precautionary rule—the highest of the 16 mean ratings observed.

### Experiment 2: Are Different Emotions Elicited when Children Violate Poison-related Rules?

Experiment 1 only included one precautionary vignette that related to accidental poisonings and it only dealt with a non-ingested poison (poisonous snakes). Conceivably, disgust might be differentially associated with accidentally ingested poisons—the focus of the Mr. Yuk program. Moreover, given that disgust was the lowest rated emotion in general, there may potentially have been some bias against the disgust faces. Perhaps, for example, participants felt that the emotion was appropriate, but that the displayed intensity was inappropriate: either too weak or too strong? We, therefore, replicated Experiment 1 with a different set of vignettes involving external poisons, internal poisons, and potentially disgusting outcomes.

### Method

#### Participants

Participants were an additional 30 females ($M = 19.4$ years) and 18 males ($M = 19.9$ years; age range of both sexes $= 16–25$ years, $SD = 1.6$ years) recruited and tested in public places on the same campus. Participant demographics, the study incentive, and informed consent process were identical to the first experiment.

### Table I. Experiment 1: The Effects of Specific Emotional Reactions

<table>
<thead>
<tr>
<th>Test</th>
<th>$F$-score (1, 46), effect size</th>
<th>Relevant means*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anger</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domain</td>
<td>67.54**, $r^2 = .60$</td>
<td>PC: M = 3.67 ($\pm .39$); SC: M = 5.55 ($\pm .28$)</td>
</tr>
<tr>
<td>Violator</td>
<td>0.00, $r^2 = .00$</td>
<td></td>
</tr>
<tr>
<td>Domain × Violator</td>
<td>0.18, $r^2 = .00$</td>
<td></td>
</tr>
<tr>
<td>Disgust</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domain</td>
<td>21.23**, $r^2 = .32$</td>
<td>PC: M = 2.49 ($\pm .37$); SC: M = 3.40 ($\pm .43$)</td>
</tr>
<tr>
<td>Violator</td>
<td>6.33*, $r^2 = .12$</td>
<td>A: M = 3.36 ($\pm .48$); C: M = 2.53 ($\pm .33$)</td>
</tr>
<tr>
<td>Domain × Violator</td>
<td>0.24, $r^2 = .01$</td>
<td></td>
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<tr>
<td>Fear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domain</td>
<td>275.26**, $r^2 = .86$</td>
<td>PC: M = 6.03 ($\pm .21$); SC: M = 2.94 ($\pm .31$)</td>
</tr>
<tr>
<td>Violator</td>
<td>0.59, $r^2 = .01$</td>
<td></td>
</tr>
<tr>
<td>Domain × Violator</td>
<td>0.03, $r^2 = .00$</td>
<td></td>
</tr>
<tr>
<td>Surprise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domain</td>
<td>69.28**, $r^2 = .60$</td>
<td>PC: M = 5.63 ($\pm .24$); SC: M = 4.07 ($\pm .33$)</td>
</tr>
<tr>
<td>Violator</td>
<td>6.06*, $r^2 = .12$</td>
<td>A: M = 5.12 ($\pm .36$); C: M = 4.60 ($\pm .37$)</td>
</tr>
<tr>
<td>Domain × Violator</td>
<td>0.77, $r^2 = .02$</td>
<td></td>
</tr>
</tbody>
</table>

Note: PC, precaution; SC, social contract; A, adult; C, Child.

*95% confidence intervals in parentheses.

*p < .05, **p < .001.
Materials and Procedure
The procedure and design of the study was the same as that utilized in Experiment 1 except that a different range of vignettes was employed and none of the models displaying the facial expressions were Japanese males. Participants worked on nine different tasks. Three vignettes involved an external poison (venomous snakes, stinging jellyfish, and a contact poison), three vignettes involved an ingested poison (a fruit which is poisonous if not prepared properly, poisonous wild mushrooms, and rat poison), and three vignettes involved disgusting substances and objects (cockroach feces, a washcloth used to clean puss from a wound, and water from a bedpan).

Results and Discussion
The ratings for each participant were averaged across the three external poison tasks, the three ingested poison tasks, and the three disgust tasks then entered into a three-way mixed MANOVA with emotion (anger, disgust, fear, and surprise) and domain (external poison, ingested poison, and disgust) as within-subjects variables and violator age (adult vs. child) as a between-subjects factor. Unlike Experiment 1, there was no significant main effect for violator age, \( F(1, 46) = 2.70, p > .10, r^2 = .06 \), but there were significant effects for domain, \( F(2, 45) = 13.84, p < .001, r^2 = .38 \), and emotion, \( F(3, 44) = 102.25, p < .001, r^2 = .88 \). These, however, were qualified by a significant domain \( \times \) emotion interaction, \( F(6, 41) = 37.29, p < .001, r^2 = .85 \). There were no additional significant interactions. Again, four separate domain \( \times \) violator age MANOVAs were conducted on each emotion separately. The results of these MANOVAs are presented in Table II.

As can be seen, participants associated angry reactions equally with external poisonings and disgusting situations and significantly more than they associated anger with ingested poisons. As might be expected, participants associated disgust with the disgusting situations more so than they did for either of the poisoning domains, which were not significantly different from one another. Fear was most strongly associated with ingested poisonings, followed by external poisonings, and least with the disgusting situations. Likewise, surprise was associated most strongly with ingested poisonings, followed by external poisonings, and least with the disgusting situations.

We surmise that participants judged fear to be the most likely emotion to be expressed in reaction to an ingested poisoning and disgust to be the least likely emotion. This was the case for both adult and child ingested poisonings. Participants were not generally biased against selecting disgust expressions as disgust was rated highly likely to be expressed in the disgusting situations. However, the fact that disgust actually ranked second after fear for judged likelihood even on the disgust

<table>
<thead>
<tr>
<th>Test</th>
<th>F-score, effect size</th>
<th>Relevant means*†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anger</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domain(^{a})</td>
<td>22.88*, ( r^2 = .50 )</td>
<td>E: ( M = 3.76 ) (± 3.7) = D: ( M = 3.69 ) (± 3.6) &gt; I: ( M = 2.85 ) (± 30)</td>
</tr>
<tr>
<td>Violator(^{b})</td>
<td>3.54, ( r^2 = .07 )</td>
<td></td>
</tr>
<tr>
<td>Domain ( \times ) Violator(^{a})</td>
<td>0.86, ( r^2 = .04 )</td>
<td></td>
</tr>
<tr>
<td>Disgust</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domain(^{a})</td>
<td>92.20*, ( r^2 = .80 )</td>
<td>D: ( M = 4.83 ) (± 3.6) &gt; I: ( M = 2.31 ) (± 30) = E: ( M = 2.09 ) (± 25)</td>
</tr>
<tr>
<td>Violator(^{b})</td>
<td>0.47, ( r^2 = .01 )</td>
<td></td>
</tr>
<tr>
<td>Domain ( \times ) Violator(^{a})</td>
<td>0.44, ( r^2 = .02 )</td>
<td></td>
</tr>
<tr>
<td>Fear</td>
<td></td>
<td></td>
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<tr>
<td>Domain(^{a})</td>
<td>36.11*, ( r^2 = .62 )</td>
<td>I: ( M = 6.14 ) (± 2.4) &gt; E: ( M = 5.69 ) (± 24) &gt; D: ( M = 4.87 ) (± 32)</td>
</tr>
<tr>
<td>Violator(^{b})</td>
<td>0.54, ( r^2 = .01 )</td>
<td></td>
</tr>
<tr>
<td>Domain ( \times ) Violator(^{a})</td>
<td>0.02, ( r^2 = .00 )</td>
<td></td>
</tr>
<tr>
<td>Surprise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domain(^{a})</td>
<td>18.50*, ( r^2 = .45 )</td>
<td>I: ( M = 5.66 ) (± 2.4) &gt; E: ( M = 5.27 ) (± 27) &gt; D: ( M = 4.73 ) (± 27)</td>
</tr>
<tr>
<td>Violator(^{b})</td>
<td>0.03, ( r^2 = .00 )</td>
<td></td>
</tr>
<tr>
<td>Domain ( \times ) Violator(^{a})</td>
<td>0.34, ( r^2 = .02 )</td>
<td></td>
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</tbody>
</table>

Note. D, disgust; E, external poison; I, ingested poison. Post hoc tests (Bonferroni): ‘=’ means no significant difference, ‘>’ means significantly greater.

*95% confidence intervals in parentheses.
†df = 2, 45.
‡df = 1, 46.
†*p < .001.
situations suggests that there may have been a slight bias against the disgust face. Regardless, fear rather than disgust expressions appear to be more well-suited toward conveying prevention messages to children about ingested poisons.

**Experiment 3: Do Children Associate Fear with Ingested Poisonings?**

Although adults believe that they would react with fear to a child’s ingesting a poison, it is entirely possible that young children might not share this belief. In this final study (Experiment 3), we investigate whether 3- and 4-year-old children share the same beliefs as adults regarding how someone would react to ingested poisonings, contrasted with reactions to violations of social contracts.

**Method**

**Participants**

The participants were 3- and 4-year-old children enrolled at various not-for-profit child care centers in a regional Australian city. Although the parents of the children were not requested to provide any information about their race or socio-economic background, a majority of the children were white and attending childcare centers with an enrollment of predominantly middle to upper class families, with seven children attending a center that primarily enrolls underprivileged families. Fifty-seven children were recruited to participate in the study but two were eliminated from the study failed to correctly answer one or more of these comprehension questions. In each vignette, the parent of a child made a rule that the child was supposed to follow, but the child later broke the rule and the parent observed this. The participants’ task was to indicate how the parent would react by pointing to one of three photos depicting the emotions: anger, disgust, and fear.

Unlike the previous two experiments, each of the emotions was depicted by the same person (within a task) as it was assumed that children would find the use of different models within the same task confusing. As a result, facial expression photographs were taken from the FG-NET Database of Facial Expressions and Emotions from the Technical University, Munich (Wallhoff, 2006). This is a database containing facial images showing a number of models expressing different basic emotions. The emotions were elicited from the models by playing video clips or still images designed to elicit specific emotions instead of telling the person to pose an expression. This ensured that the depiction of emotions used in this study were authentic, though perhaps more subtle than posed expressions. The facial expressions of two models, an adult male and an adult female (described as the child’s father/mother), were selected for use in this study. Our color reproductions of these photos measured 9 cm × 13 cm (copies of the images used may be obtained by contacting the authors).

Prior to testing the materials with child participants, the tasks (minus the comprehension questions) were printed out and pilot tested on 24 adult participants at a campus cafeteria (from the same participant pool as Experiments 1 and 2). The adults’ performance was at ceiling. Nineteen out of 24 adults selected the fearful face as the most likely response for the “Laundry Detergent”
task, 22 out of 24 selected the fearful face for the “Poisonous Berry” task, 23 out of 24 selected the angry face for the “Toys/Ice Cream” task, and 24 out of 24 selected the angry face for the “Veggies/Play” task.

The child participants were tested in partially secluded areas of the centers’ playrooms in order to avoid distraction from other children. Tasks were presented verbally and in a randomized order. At the end of each vignette the child was asked to choose the photograph of the parent, also in randomized order, when they saw the child either eating the poisonous substance for the poisoning tasks, or not doing what they were told in social contract tasks [see Appendix I for a sample poison scenario]. Although the Experimenter (the first author) was not naïve to the hypothesis being tested, the study protocol required that she look directly at the table in front of her—and not at the photos—after asking the child to select a photo. This attempted to minimize any cuing of the participants. Once the participant had selected a photograph, they were praised with a “well-done” comment and the next task was started. It took ~10–15 min for each participant to complete the entire testing process.

Results and Discussion

For each child the frequency with which they selected each emotion for each domain (poisoning vs. social contract) was computed (Table III) and entered into a series of Wilcoxon signed ranks tests (all p-values are one-tailed and exact unless otherwise noted). Collapsing across the age categories, children selected fear for the poisoning tasks significantly more often than either disgust, $z = 3.56$, $p < .001$, $r^2 = .12$, or anger, $z = 4.03$, $p < .001$, $r^2 = .15$. Conversely, for the social contract tasks, the children selected angry faces most often, but this was not significantly different from either the frequency of disgust selections, $z = 1.03$, $ns$, $r^2 = .01$, or the frequency of fear selections, $z = 1.50$, $ns$, $r^2 = .02$. However, like the adults, children associated fear more with the poisonings than the social contract violations, $z = 3.47$, $p < .001$, $r^2 = .11$, and they associated anger more with the social contract violations than the poisonings, $z = 3.41$, $p < .001$, $r^2 = .11$.

The social contract results were less like typical adult results because the 3-year-olds preferred to select the disgust faces over the anger faces, however, the frequency with which they selected disgust for the social contract violations was not significantly different from the frequency with which they selected anger, $z = 1.59$, ns (2-tailed, exact), $r^2 = .06$, or fear, $z = 1.75$, ns (2-tailed, exact), $r^2 = .08$. The 4-year-olds, on the other hand, selected anger most often for the social contract violations, at levels that were significantly different from those for disgust, $z = 2.31$, $p < .02$, $r^2 = .28$, but not significantly greater than those for fear, $z = 1.61$, $p < .07$, $r^2 = .19$. Hence, while the 4-year-olds also selected anger more often for the social contract violations than the poisonings, $z = 3.02$, $p < .01$, $r^2 = .13$, there was no significant difference in anger selections across domains among the 3-year-olds, $z = 1.66$, $ns$, $r^2 = .07$. This age difference reflected a significant trend for the older participants to select anger more often for the social contract violations, $r = .281$, $p < .05$, $r^2 = .08$. Conversely, there was no such trend evident for the selection of fear for the poisoning tasks, $r = -.103$, $ns$, $r^2 = .01$. Both the 3-year-olds, $z = 2.88$, $p < .01$, $r^2 = .21$, and the 4-year-olds, $z = 2.36$, $p < .02$, $r^2 = .08$, selected the fearful faces more often for the poisonings than the social contract violations, suggesting that performance in the two domains follows different developmental trajectories.

General Discussion

Although Mr. Yuk stickers are no longer recommended for use as a deterrent and instead are recommended for educational uses, many agencies and poison control centers continue to advocate the use of Mr. Yuk stickers as a deterrent. Our results suggest that adults and young children alike expect people to react with fear, not disgust, in response to poisonings. For reasons that we shall discuss, we believe this calls into question the appropriateness of using facial expressions of disgust when communicating messages about accidental poisonings to young children. Prior to commenting on the limitations of disgust, we consider the limitations of our study.

There is a possible alternate explanation for the children’s failure to select the disgust face for the poisoning scenarios in that children simply might not prefer

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**Table III. Experiment 3: Average Frequency with which Emotions were selected**

<table>
<thead>
<tr>
<th>Domain</th>
<th>Anger</th>
<th>Disgust</th>
<th>Fear</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-year-olds (N = 20)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poisoning</td>
<td>0.20</td>
<td>0.55</td>
<td>1.25</td>
</tr>
<tr>
<td>Social contract</td>
<td>0.55</td>
<td>0.95</td>
<td>0.50</td>
</tr>
<tr>
<td>4-year-olds (N = 35)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poisoning</td>
<td>0.37</td>
<td>0.57</td>
<td>1.06</td>
</tr>
<tr>
<td>Social contract</td>
<td>0.94</td>
<td>0.46</td>
<td>0.60</td>
</tr>
<tr>
<td>Combined</td>
<td>0.31</td>
<td>0.56</td>
<td>1.13</td>
</tr>
<tr>
<td>Poisoning</td>
<td>0.80</td>
<td>0.64</td>
<td>0.56</td>
</tr>
</tbody>
</table>
disgust facial expressions. The Mr. Yuk character was selected because he was the least popular of the designs tested with children (Mennear, 1977). However, the wider pattern of results indicates that this is not likely the case given that the younger cohort actually favored the disgust facial expressions for the social contracts. Similarly, the fact that fear was not the modal expression selected for the social contracts also eliminates the possibility that the children have a bias for selecting fear facial expressions, giving a spurious association between fear and precautions.

This interaction also rules out the influence of several potential demand characteristics. For example, anger and disgust expressions are very similar in appearance with eyebrows pulled down whereas fear expressions feature wide-open eyes. Hence, the fear expressions are more distinctive and, for this reason, the children may have been prompted to select them. By the same argument, they should have also favored the fear faces for the social contract violations, but they did not. Averaging across the 3- and 4-year-olds, fear was the least favored emotion for the social contract scenarios, suggesting that the distinctiveness of the fear expressions was not a factor biasing the results.

One demand characteristic that could potentially result in the observed interaction is unintentional cuing by the Experimenter. The adoption of a standardized testing procedure aimed to avoid such cuing (though this was not independently verified). It is also not clear whether the adoption of a double-masked testing protocol would have provided further safeguards against cuing. Given that the adults in the pilot study for Experiment 3 almost universally selected the predicted faces, even an adult masked to the hypothesis of the study could unintentionally cue the children based on their own naïve understanding of the task. One potential solution to this problem is the use of a computer-assisted testing procedure. Future investigations might consider the use of such a testing protocol to address this issue.

Two concerns arise with respect to the generalizability of our results, namely the age of the children tested and their Australian background. Although no age effects were observed for the poisoning scenarios, younger children (<3-years-old) would undoubtedly perform more poorly, though we have no means of assessing at what age children might first display some competence in their appreciation of adult reactions. Two-year-olds, who are also vulnerable to accidental poisonings, might completely fail to distinguish between different facial expressions of emotion. However, there is experimental evidence to suggest that children as young as 12 months of age can distinguish between facial expressions of different negative emotions (Sorce et al. 1985; see below). Moreover, the children in our study all would have had previous instruction regarding poisonous snakes and spiders at their child care centers given the potential threat they pose in Australia. In contrast, children in temperate climates are less likely to receive early instruction, if any, regarding poisonous snakes and spiders. Our Australian child participants’ understanding of poisonings might exceed that found in children where these hazards do not exist. Future attempts to replicate our results could clarify the lower age bound of children’s competence and the influence that instruction about poisons has on this.

**Implications for Fear Appeals**

The fear induced by fear appeals can influence behavior independent of any cognitive effects of the message (Dillard, 1994). Hence, fear appeals might also be effective in promoting health protective behaviors in young children—despite their cognitive limitations—provided they have some comprehension of hazards and fear. Our results suggest that 3- and 4-year-olds possess such knowledge. While our child participants might not fully understand accidental poisonings per se, even 12-month-old infants appear capable of assessing environmental hazards and reacting with fear, as demonstrated by the visual cliff paradigm (Richards & Rader, 1983). Consequently, fear appeals might be considered for use in public health and safety campaigns directed at young children, provided that their design is psychologically and developmentally informed and tested for effectiveness.

Although the results support our claim that Mr. Yuk displays a suboptimal facial expression to achieve its desired ends, this (in itself) might not be the cause of Mr. Yuk stickers’ failure as deterrents. Studies of adult fear appeals combining fear-eliciting verbal messages with disgust-eliciting images suggest that these may be less effective than messages that focus on a single emotion (Lesner et al., in press, 2007). This raises the possibility that it is the mixture of a disgust-eliciting image (Mr. Yuk stickers) with a fear-eliciting verbal message (cf., the Idaho Department of Health and Welfare’s advice to “teach your children that his green, scowling face means danger”) that has undermined Mr. Yuk stickers’ deterrence property. This will need to be clarified in future research.

The Mr. Yuk program illustrates the concerns Dillard (1994) raised about the use of emotions in fear appeals. As Dillard notes, emotions are not interchangeable. Each emotion engages distinct psychological processes. With respect to the emotional experiences of young children, the social referencing literature suggests that adult expressions of emotion play an important role in the regulation
of children’s behavior. Therefore, the fact that Mr. Yuk utilizes an adult facial expression of emotion and seeks to regulate the behavior of children is not psychologically incidental. The form of the emotional message and the target audience suggest that a specific psychological process, i.e., social referencing, will be engaged. We do not mean to caution against the use of facial expression of emotion when conveying health-protective messages to young children. Rather, we simply wish to echo Dillard in advising that emotions be used in a way that is highly specific and informed by a scientific understanding of emotions and how they operate in different communicative contexts.

**Social Referencing as an Aid to Child Safety**

Numerous studies have shown that facial and vocal expressions of negative emotions, including both fear and disgust, can modify infant behavior (see Vaish et al., 2008, for a review). By the 14th month of life, these negative social referencing effects can persist for up to an hour after an adult model has reacted to the situation, suggesting the potential for durable changes in infant behavior (Hertenstein & Campos, 2004). Vaish et al. (2008) suggest that social referencing of negative emotions has the evolved function of helping infants avoid harmful situations. One of the advantages of this built-in system for communicating information about environmental hazards is that the system is capable of modifying the behavior of infants and toddlers lacking higher cognitive functions such as language and symbolic reasoning. Our results suggest that by the age of three, children might already be able to use this evolved warning system to distinguish between different types of hazards.

However, there are also limitations to social referencing that suggest other possible reasons for the failure of the Mr. Yuk program, and these should be explored further. For example, Moses, Baldwin, Rosicky, and Tidball (2001) observed that 12- and 18-month-old infants only altered their behavior towards novel objects when they were provided naturalistic cues about the source of an adult’s affective response, such as eye gaze and joint attention. As a static, two-dimensional depiction of an emotional expression, Mr. Yuk stickers might also fail to convey their intended message because they likewise lack these reference cues. Older 3- and 4-year-old children may or may not be able to compensate for the lack of these reference cues. Alternatively, complementary emotional displays provided by parents when they place warning stickers on household poisons in their children’s presence might not only compensate for the lack of such reference cues, but also might be sufficient in themselves to effectively signal to their children that the item should be avoided. These are among the issues needing exploration when designing safety messages and deterrents for young children.

Given the importance of eye gaze and joint attention to social referencing, it is possible that children with autistic spectrum disorder (ASD), who often display deficits in these abilities (Baron-Cohen, 1995) might be less inclined to social reference adult models in hazardous situations. Indeed, while children with ASD are capable of distinguishing different facial expressions of emotion (Castelli, 2005), they are less likely to social reference adults when presented with an ambiguous stimulus (Bacon, Fein, Morris, Waterhouse, & Allen, 1998). More importantly, children with ASD have been shown to display significantly less appropriate responses to adult displays of fear (Sigman, Kasari, Kwon, & Yirmiya, 1992). These findings suggest that children with ASD might be less likely to benefit from emotion-based prevention messages. Whether supplementing nonverbal messages (e.g., facial expressions) with explicit verbal messages about harmful effects enhances the effectiveness of health protective messages directed at children is also worth exploring, not simply for the enhanced effectiveness of such messages, but also as an aid for children who do not spontaneously take account of nonverbal displays of emotion.

Although we have assumed that the emotion should match the message, we have not provided any evidence that this is necessary for effective behavioral control. We have not excluded the possibility that expressions of other negative emotions would work just as well in regulating children’s behavior in dangerous situations. However, Sorce et al.’s (1985) study on social referencing and the visual cliff suggests that matching the emotion to the situation is important for behavioral regulation in young children. None of the children in that study crossed a visual cliff when their parents expressed fear, whereas 11% would cross the cliff when anger was expressed and 33% would cross when sadness was expressed. Considering this finding and the adult findings on the effectiveness of mixed messages, we would recommend that the designers of fear appeals directed at young children test both children and adults to determine what emotion the health or safety concern normally evokes most strongly, and then devise a message that exclusively elicits that emotion.
Although we believe that there is the potential to improve the effectiveness of warning stickers, stickers, and visual warnings—no matter how strong or powerful they are—are no substitute for safe and effective parenting practices with young children. In particular, great care should be taken with the storage and access of poisons—a message actively promoted by the Mr. Yuk program (Children’s Hospital of Pittsburgh, 2002).

Acknowledgments

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Appendix I. Laundry Detergent Scenario Employed in Experiment 3

Note. This version was administered to child participants. The adult version contained identical content, but was not conversational and omitted the comprehension questions.

Experimenter: “Do you know what this is?” [pointing at box of laundry detergent/washing powder].

Experimenter: “This is washing powder. Your mum uses this to wash clothes. It is poisonous so eating it will make you sick”

Experimenter: “If you see this will you eat it?” [comprehension question – if the child failed to say ‘no’ then he or she was later eliminated from the study].

Experiment: “Now I am going to show you some photos of Sally’s mum.” [Photos of adult woman with expressions of anger, fear, and disgust are shown.] “Choose the photo of Sally’s mum when she sees Sally eating the washing powder.”

[Participant responds and was praised with “well-done”].

References


