

# A Facial Expression of Pax: Revisiting Preschoolers' "Recognition" of Expressions

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A FACIAL EXPRESSION OF PAX:  
REVISITING PRESCHOOLERS' "RECOGNITION" OF EXPRESSIONS

a dissertation

by

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## **A Facial Expression of Pax: Revisiting Preschoolers' "Recognition" of Expressions**

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Prior research showing that children recognize emotional expressions has used a choice-from-array style task; for example, children are asked to find the fear face in an array of several expressions. However, these choice-from-array tasks allow for the use of a process of elimination strategy in which children could select an expression they are unfamiliar with when presented a label that does not apply to other expressions in the array. Across six studies (N = 144), 80% of 2- to 4-year-olds selected a novel expression when presented a target label and performed similarly when the label was novel (such as *pax*) or familiar (such as *fear*). In addition, 46% of children went on to freely label the expression with the target label in a subsequent task. These data are the first to show that children extend the process of elimination strategy to facial expressions and also call into question the findings of prior choice-from-array studies.

## A Facial Expression of Pax: Revisiting Preschoolers' "Recognition" of Expressions

When presented an array of three facial expressions – for example, expressions intended to convey happiness, sadness, and fear – and asked to find the person who is fearful, preschoolers successfully select the fearful expression more often than would be expected by chance. The choice-from-array task has been the gold standard in the field for exploring whether children recognize facial expressions and has been used to show that preschoolers recognize happiness, sadness, anger, fear, surprise, disgust, and even pride (Denham, McKinley, Couchoud & Holt, 1990; Harrigan, 1984; Izard, 1971; Székely, Tiemeier, Arends, Jaddoe, Hofman, Verhulst & Herba, 2011; Tracy, Robins & Lagattuta, 2005).

Particularly for preschoolers, the difficulty of the choice-from-array task varies with the number of expressions in the array: children's performance is higher when the array contains fewer expressions. Russell & Bullock (1985) presented two- to five-year-olds arrays of two expressions, with the expressions drawn from 9 different categories, six of which were 'basic' categories (happiness, sadness, anger, fear, surprise, and disgust) and three were not (excitement, sleepiness, and calmness). The experimenter asked children questions such as "show me the happy person." For the basic emotion categories, which are most commonly presented to children, performance matching the expected expression and label was high: 85% of children selected the expected expression when asked. Gagnon, Gosselin, Hudon-ven der Buhs, Larocque & Milliard (2010) also found high performance when they presented five- and six-year-olds arrays of two expressions, with the expressions drawn from five different categories (sadness,

anger, fear, surprise, and disgust). Seventy-two percent of children matched the expected expression and label. When presented arrays of two expressions, children's performance was high: approximately 79% of children matched the expected expression and label.

Children's performance decreases slightly when presented arrays of three expressions. Izard (1971), in one of the first studies to use the choice-from-array task with children, presented American and French children arrays of three expressions. The expressions were taken from nine categories (happiness, sadness, anger, fear, surprise, disgust, shame, contempt, and interest). Izard found that, for the six basic emotions, 63% of 2- to 5-year-olds matched the expected label with the expression. Similarly, Harrigan (1984) found that when three-year-olds' were presented arrays of three expressions, with expressions drawn from the six basic emotion categories, three-year-olds' performance was 63%. Tracy, Robins & Lagattuta (2005), when presenting three- to five-year-olds' expressions of happiness, surprise, and pride, found that 67% of children matched the expected expression and label to the expressions of happiness and surprise. Slightly fewer children (52%) matched the expression of pride with the expected label. Across these studies, preschoolers' performance was consistent: approximately 64% of children matched the expected expression and label for basic emotion categories.

Of studies that have presented children arrays of four expressions, results are mixed. Walden & Field (1982) found that when 3- to 5-year-old children were presented an array containing drawn expressions of happiness, sadness, anger, and surprise, 71% of children matched the expected expression and label. Denham & Couchoud (1990) and Székely et al. (2011) both presented children arrays containing expressions of happiness,

sadness, anger, and fear, although Denham & Couchoud presented drawn expressions whereas Székely et al. (2011) presented photographs. Denham & Couchoud (1990) found that 69% of 3- and 4-year-olds matched the expected expression and label, but Székely et al. (2011) found that only 50% of three-year-olds did. Variations in children's performance across these studies could stem from several factors: the emotion categories presented, the kind of expression presented (drawn vs. photographs), or the age groups in question. However, children's performance when presented arrays of four expressions was similar to that when presented arrays of three expressions: approximately 63% of children matched the expected expression and label.

One study has presented children more than four expressions in a choice-from-array task. Bullock & Russell (1984) presented three- to five-year-olds arrays of 10 expressions, with the expressions drawn from 10 categories (happiness, sadness, anger, fear, surprise, disgust, excitement, sleepiness, calmness, plus neutral). Bullock & Russell found that for the basic emotion categories, fewer than half of children (44%) matched the expected expression and label when the array was large.

Although children's performance varies with the number of expressions presented in the array, many researchers conducting these choice-from-array studies reasonably concluded that children recognized the expressions as displaying fear, disgust, pride, and so on. Evidence of expression recognition in young children has been taken as evidence that 'basic' facial expressions convey privileged information and that recognition of these expressions emerges early in childhood or even infancy (Charlesworth & Kreutzer, 1973; Ekman, 1989; Ekman & Cordardo, 2011; Izard, 1971, 1994, 2011; LaBarbera, Izard,

Vietze & Parisi, 1976). This evidence of recognition in infancy is taken to echo evidence from adults, who perform similarly or higher than children. In addition, adults are hypothesized to experience basic emotions in the same way across cultures and to express these emotions via specific facial expressions that are then automatically and easily recognized by others (Ekman, 1980; Ekman and Friesen, 1978; Ekman, Friesen, and Ellsworth, 1972; Haidt & Keltner, 1999; Izard, 1971, 1977; Matsumoto, Ollide, Schug, Willingham & Callan, 2009; Tracy & Robins, 2008). These theories have led some to conclude that emotional expression recognition is evolutionarily based and a universally human ability (Izard, 1992, 1994; Ekman, 1971; Ekman et al, 1987).

Although a majority of preschoolers appear to recognize facial expressions when presented a choice-from-array task, this is not the case when they are asked to freely label the emotion conveyed by a given expression: preschoolers' spontaneous labeling of these same expressions is markedly lower (Gates, 1923; Izard, 1971; Markham & Adams, 1992; Widen & Russell, 2003, 2008). For example, in the choice-from-array task, 62% of two- to four-year-olds match the fearful expression with the label (Izard, 1971), but in a free-labeling task, only 39% spontaneously label the expression (Widen & Russell, 2003). The results of free labeling and forced-choice tasks are commonly compared in the emotion literature, but some may argue that this comparison is inappropriate as the chance guessing rates for these tasks differ. The choice-from-array task may be interpreted as giving children a limited set of choices so that 33% of choices from an array of 3 faces would be correct, whereas in free labeling, the chance rate of producing any given word is effectively zero. This line of reasoning might suggest that the choice-



from-array task inflates children's performance, but many researchers have simply concluded that children's performance differs on these tasks.

Some have hypothesized that the difference between children's performance in choice-from-array and free labeling tasks stems from the vocabulary demands of free labeling (Denham & Couchoud, 1990; Izard, 1971), but in this paper I explore an alternative explanation: The forced-choice nature of the choice-from-array tasks allows for the use of a process of elimination in responding. If children use this strategy in emotion recognition tasks, they may appear to recognize an expression, even if they are unfamiliar with the emotion label or expression presented. Children may match a label with an expression simply because they know that the label does not apply to other expressions in the array, a strategy they would be unable to use in a free labeling task. If children's use a process of elimination in emotion recognition tasks, then their performance may be artificially inflated in choice-from-array tasks and relatively lower in free labeling tasks.

Preschoolers and toddlers have been shown to use the process of elimination as a word learning strategy; children match labels they are unfamiliar with to objects that they do not yet have a label for. Children's use of a process of elimination to match novel labels with novel objects was first illustrated in relation to color. Children were presented nine cards, each a different color. Eight cards were known colors (e.g. blue, brown, red) and one was an unknown color (olive green). Children were asked to find the "chromium one" (Carey & Bartlett, 1979). Sixty-three percent of three-year-olds successfully matched the novel label *chromium* with the novel color olive green. In

addition to color, toddlers and children use the process of elimination to match novel labels with objects (Au & Markman, 1987; Baldwin, Markman, Bill, Desjardins, Irwin & Tidball, 1996; Graham, Nilsen, Collins & Olineck, 2010; Grassman, Stracke & Tomasello, 2009; Halberda, 2006; Jaswal & Hansen, 2006; Markman, 1990; Markham & Wachtel, 1987), animals (Au & Glasman, 1990; Bialystok, Barac, Blaye & Poulin-Dubois, 2010), verbally provided facts (Diesendruck & Markson, 2001; Waxman & Booth, 2000), adjectives (Diesendruck, Hall & Graham, 2006; Waxman & Booth, 2001; Waxman & Markow, 1998), and actions (Haryu, Imai & Okada, 2011; Waxman, Lidz, Braun & Lavin, 2009).

That children use a process of elimination to match novel labels to novel things is agreed upon in the literature, but the mechanism underlying this process has been debated. One suggested mechanism is mutual exclusivity – the assumption that all things have just one name (Markman, 1990). Using mutual exclusivity, children would conclude that since the experimenter did not name the known object (e.g. a cup), the label must apply to the other, novel object. A second suggested mechanism is the pragmatic account of word learning – the idea that speakers and listeners behave in a cooperative manner to communicate (Diesendruck & Markson, 2001). Using this mechanism, children conclude that the speaker has provided a label relevant to the situation and does not want the cup because they did not ask for it – therefore, they must want the novel object. A third mechanism employs the principle of contrast – the idea that novel words contrast with known words (Clark, 1990). Using this mechanism, children would match a novel label with a novel object because the novel label necessarily signifies a new

category of object. A final, fourth mechanism is the novelty hypothesis – the idea that children are intrinsically motivated to match novel labels and novel objects (Mervis & Bertrand, 1994). Using this mechanism, children would simply note the presence of a new word and a new object and conclude they are associated. Although these four hypothesized mechanisms reference similar processes, and each mechanism is likely used by word learners at some point in development, the debate in the field continues as to which mechanism is most important and when each mechanism is employed.

Whether children apply the process of elimination strategy to emotion recognition tasks is yet undetermined, but the structure of the choice-from-array task allows for the use of this strategy; children could then appear to ‘recognize’ emotional expressions even if they had no experience with the expressions or the label. The choice-from-array task may also teach children the expected labels for facial expressions, much in the same way that tasks in prior research taught children labels for colors or gestures.

To determine whether children can use the process of elimination in choice from array tasks to match labels to expressions, I conducted a series of six studies in which preschoolers (two- to four-year-olds) were presented arrays of three facial expressions. In each array, two expressions - happiness and sadness or anger - were likely familiar to children, as shown in prior research using both free labeling and choice-from-array tasks (Bullock & Russell, 1985; Camras & Allison, 1985; Denham & Couchoud, 1990; Gates, 1923; Walden & Field, 1982; Widen & Russell, 2003, 2008). The third expression was novel and one children were unlikely to be familiar with. Children were then asked to find expressions in the array. They were presented labels that applied to the familiar

expressions in the array (e.g. “Do you see anyone who feels happy?”) and also novel labels that did not apply to the expressions in the array (e.g. “Do you see anyone who feels pax?”). Children who indicate that the person displaying the novel expression feels pax are likely using the process of elimination to determine the expected label of the expression.

In Study 1, children viewed arrays of three facial expressions - happiness, sadness, and a novel expression - and were presented with the labels *happy*, *sad* and *pax* (or *tolen*, in half of the cases). The dependent measure was whether children would match the novel label with the novel expression and therefore appear to ‘recognize’ the expression even though they were unfamiliar with the novel expression and label. As a final trial, children freely labeled each expression to determine whether the associations made during the choice-from-array task between the novel expression and label would be applied in a subsequent task.

It is possible that children’s performance in both the choice-from-array and free labeling tasks will be higher for the known expressions and labels (*happy* and *sad*) than the novel expression and label, simply because the known labels and expressions will be more familiar to them. However, there is no reason to anticipate variations across the two novel labels (*pax* and *tolen*), as they are equally unfamiliar to children.

## Study 1

### Method

**Participants.** Participants were 24 children, with 8 children in each of three age groups: two-year-olds ( $M = 29.8$  mos.,  $SD = 3.7$  mos.), three-year-olds ( $M = 42.3$  mos.,

SD = 3.5 mos.), and four-year-olds (M = 50.0 mos., SD = 1.5 mos.). Each age group included an equal number of males and females. All children were fluent in English and tested in the greater Boston area. In addition, two adult comparison groups (N = 10; N = 10) evaluated the materials for this study.

**Materials.** One female and one male adult each posed expressions of happiness, sadness, anger, and an expression not previously associated with any emotion: a puffed-cheeks expression (Action Unit = 34; Ekman & Friesen, 1978). One adult comparison group (N = 10) was asked to rate the puffed-check expression plus several other novel expressions as positive or negative in valence. Half of the adult participant group rated the puffed-cheeks expression as positive and half rated it as negative. As the puffed-cheeks expression was not rated more positive than negative, it was chosen as a novel expression reasonably neutral in valence. The second adult comparison group (N = 10) freely labeled the puffed-cheeks expression to determine whether the expression was consistently identified as conveying a specific emotion. In response to the question “How does she/he feel?”, 3 of the 10 participants labeled the expression as *frustrated*, and 2 labeled it as *overwhelmed*. All other labels (*angry, bloated, full, nauseous, sick*), were generated only once. The varied responses generated for the expression indicated that it was not viewed as conveying any single, specific emotion.

**Procedure.** Before participating, children were randomly assigned to hear one of two novel labels used in the study: *pax* or *tolen*.

**Animal Labeling.** As a familiarization task, and to ensure that children could respond to the experimenter’s questions appropriately, children were first presented an

array of three animal pictures: a cat, a dog, and a rabbit. The experimenter asked: “Do you see a cat (dog, rabbit)?” Children were asked to identify each animal in the array once. All children pointed to the correct animals in the array as requested by the experimenter.

**Priming.** Children next underwent a priming procedure to increase the accessibility of the emotion labels as well as to introduce the novel label. The experimenter initiated a conversation with the child about feelings and asked questions such as “happy is a feeling; have you ever felt happy?” Children’s responses to the experimenter’s question were not corrected. The labels targeted in the priming session were those that were to be presented in the study – *happy*, *sad* and *pax* (or *tolen*, in half of cases). Children heard each target label twice before participating.

**Choice-from-array task.** For the first array, children viewed three facial expressions which were arranged in random order and remained on the table throughout the trial (happiness, sadness, and puffed-cheeks). The expressions were posed by either a male or a female poser and the order of presentation was counterbalanced. The experimenter asked for emotions in a predetermined order. Children were first asked: “Do you see anyone who feels happy?” This question was phrased in such a way that children would not assume that a person displaying the given emotion was in the array. After the child pointed to an expression (or responded that no one felt happy) children were then asked if they saw anyone who felt *sad*, and finally, *pax*.

For the second array, children viewed expressions of happiness, sadness, and puffed-cheeks, posed by the remaining poser (either male or female, counterbalanced).

The order of label presentation was partially random; first, children were either asked if they saw anyone who felt *happy* or anyone who felt *sad*. Second, children were asked if they saw anyone who felt *pax*. Pax was presented second so that if children were using a process of elimination to match labels to expressions, they would still have to choose between the two remaining expressions that they had not yet selected. Third, children were asked to find the emotion not asked for on the first trial (e.g.: if *happy* was asked for on the first trial, *sad* would be asked for on the third trial).

**Free Labeling Task.** Next, children freely labeled the happy, sad, and puffed-cheeks expressions that they saw in the first choice-from-array trial. Children were shown each picture one at a time, in a random order, and were asked, “How does he/she feel?” Children were free to give any emotion label they chose.

**Scoring.** For the choice-from-array task, children’s responses were coded for whether they matched the expected label with the expected expression (coded as a 1) or not (coded as a 0). For each emotion category, children’s scores across the two arrays were averaged, resulting in a recognition score ranging between 0 and 1. For the free labeling task, children’s responses were sorted by three independent coders into one of the following categories: happiness, sadness, anger, fear, surprise, disgust, or pride. Any responses for which coders could not agree were categorized as other. Responses categorized as correct for happiness were: *happy*; responses categorized as correct for sadness were: *sad*; responses categorized as correct for pax or tolen were: *pax*, *paxes*, and *tolen*.

## Results

As shown in Table 1, the mean recognition score for preschoolers' matching of the novel label and the novel expression was .92. This percentage is significantly greater than the .33 that would be expected by chance guessing (if children did assume that one of the three expressions was the *pax* face, their likelihood of choosing any expression would be one in three for each array, averaged across the two trials = .33), as determined by a single sample t-test,  $t(23) = 11.93$ ,  $p < .001$ . Each child had two opportunities to respond that no one in the array felt *pax*. For none of these 48 trials did children respond in such a way; all children selected an expression from the array for the *pax* label.

For the free-labeling task, 46% of children labeled the novel expression with the novel label (either *pax* or *tolen*), as shown in Table 1. This finding indicates that children were responding in a non-random manner, as the likelihood of children spontaneously labeling the novel expression as *pax* (without prior exposure to the expression and label in the choice-from-array task) is effectively zero.

To determine whether children's performance matching the novel label with the novel expression in the choice-from-array task differed from their matching of the labels *happy* and *sad* with the expected expressions, I performed a 3 (age group) x 2 (gender) x 3 (emotion label) mixed-design repeated measures ANOVA using children's recognition scores as the dependent variable. No main effects or interactions for any of these variables emerged; children's performance for the happiness, sadness, and novel expressions did not vary reliably,  $F(2, 36) = .562$ ,  $p = .52$  (Table 2).

For the free-labeling task, a 3 (age group) x 2 (gender) x 3 (expression) mixed-design repeated measures ANOVA showed that children's labeling of the expressions



with the expected label increased with age,  $F(2, 18) = 5.07, p = .02, \eta_p^2 = .36$ . Least Significant Difference (LSD) post-hoc tests showed that two-year-olds' performance was lower than that of four-year-olds ( $p = .006$ ), and nearly significantly lower than three-year-olds ( $p = .06$ ). In addition, children were less likely to match the novel label to the novel expression than they were to match the expected label with the happy or sad expressions,  $F(2, 36) = 11.45, p < .001, \eta_p^2 = .51$  (all  $p$ 's  $< .001$ ).

## **Discussion**

In the choice-from-array task, children's performance matching known emotion labels to their associated expressions was indistinguishable from their matching of the made-up expression with the made-up label – children were as likely to 'recognize' the pax face as they were to 'recognize' the sad face. These data are the first to show that children as young as two years of age can match a novel label with a novel expression in the choice-from-array task even when they have no prior knowledge of the expression or label presented.

After only a few exposures to the novel label, nearly half of children (including 88% of four-year-olds) freely labeled the novel expression with the novel label; children again appeared to 'recognize' the emotion presented. Prior to participating in this study, the novel label and novel expression presented were likely unfamiliar to children; presumably preschoolers made the association between the label and the expression during the choice-from-array task.

## **Study 2**

To ensure that the findings of Study 1 were robust and were not due to children's familiarity with expressions of happiness and sadness, I replicated Study 1 substituting an expression of anger for sadness.

## Method

The method was identical to that of Study 1 with the following exceptions.

**Participants.** The ages of participants were: two-year-olds ( $M = 30.0$  mos.,  $SD = 1.1$  mos.), three-year-olds ( $M = 41.1$  mos.,  $SD = 3.5$  mos.), and four-year-olds ( $M = 53.5$  mos.,  $SD = 3.2$  mos.).

**Materials.** Rather than including expressions of sadness in the arrays, the expressions of anger posed by the male and female poser were presented instead.

**Procedure.** Children were primed using the label *mad* instead of *sad*, and the anger expression replaced the sad expression on all test trials.

**Scoring.** For the free labeling task, responses scored as correct for anger were *angry*, *frustrated*, and *mad*.

## Results

As shown in Table 1, the mean recognition score for preschoolers' matching of the novel label and the novel expression was .81. This percentage is significantly greater than the .33 that would be expected by chance guessing,  $t(23) = 8.21, p < .001$ . Each child had two opportunities to respond that no one in the array felt *pax*. For none of these 48 trials did children respond in such a way; all children selected an expression from the array for the *pax* label. For the free-labeling task, 42% of children labeled the novel expression with the novel label.

For the choice-from-array task, a 3 (age group) x 2 (gender) x 3 (emotion label) mixed-design repeated measures ANOVA found no main effects or interactions for any of these variables, although the main effect of emotion was trending toward significance,  $F(2, 36) = 2.87, p = .07, \eta_p^2 = .14$ . As shown in Table 2, children's performance matching the expected expression and label was lower for the novel expression than for the angry expression ( $p = .05$ ), but was not different for the happy expression ( $p = .11$ ).

For the free-labeling task, a 3 (age group) x 2 (gender) x 3 (expression) mixed-design repeated measures ANOVA showed that children's labeling of the expressions varied with gender,  $F(1, 18) = 4.865, p = .04, \eta_p^2 = .21$ . Least Significant Difference (LSD) post-hoc tests showed that female participants were more likely to freely label the expressions with the expected label ( $p = .04$ ). In addition, children were less likely to match the expected label to the novel expression than the happy or sad expressions,  $F(1, 18) = 16.52, p < .001, \eta_p^2 = .48$  (all  $p$ 's  $< .04$ ). Finally, the gender and emotion main effects were qualified by an interaction,  $F(1, 18) = 4.865, p = .04, \eta_p^2 = .16$ , where female participants were more likely to freely label the sad and pax expressions with the expected label than males were (all  $ps < .05$ ).

## **Discussion**

The results of Study 2 replicated those of Study 1. In the choice-from-array task, children's performance matching known emotion labels to their associated expressions was indistinguishable from their matching of the made-up expression with the made-up label – children were as likely to 'recognize' the pax face as they were to 'recognize' the anger face. In addition, after only a few exposures to the novel label, 42% of all children

(including 63% of four-year-olds) freely labeled the novel expression as *pax*; children appeared to ‘recognize’ the emotion presented. These data show that the results of Study 1 were not chance findings; the pattern seen across these studies was similar.

### Study 3

It is possible that children matched the novel label and the novel expression in Studies 1 and 2 because they were unaware that they could answer “no” to the question “Do you see anyone who feels *pax*?” Although the question the experimenter asked children was intentionally phrased in such a way that children could respond with “no,” it is possible that this wording was not sufficient. Perhaps children would respond that no one feels *pax* if they were made explicitly aware that this response option was available, rather than continuing to match the novel expression and label. Therefore, we replicated Study 1 using an alternative animal labeling task in which children were asked to find an animal that was not in the array. This task was intended to make explicit that, on some occasions, “no” was the correct answer in this task.

### Method

The method was identical to that of Study 1 with the following exceptions.

**Participants.** The ages of participants were: two-year-olds ( $M = 29.5$  mos.,  $SD = 3.2$  mos.), three-year-olds ( $M = 41.6$  mos.,  $SD = 2.7$  mos.), and four-year-olds ( $M = 55.5$  mos.,  $SD = 1.9$  mos.).

### Procedure.

**Animal Labeling.** Children were presented with the same array of 3 animal pictures used in Study 1 (a cat, a dog and a rabbit). However, during the questioning,

children were asked “Do you see an elephant?” (not present in the array). If the child indicated that one of the animals was an elephant, the experimenter said: “No, that’s not an elephant, is it?” and repeated the question until the child acknowledged that there was no elephant in the array. All children correctly chose the animals in the array as requested by the experimenter, and all children acknowledged the absence of an elephant in the array.

## Results

As shown in Table 1, the mean recognition score for preschoolers’ matching of the novel label and the novel expression was .67. This percentage is significantly greater than the .33 that would be expected by chance guessing,  $t(23) = 4.33, p < .001$ . Each child had two opportunities to respond that no one in the array felt *pax*. For only three of these 48 trials did children respond in such a way (in addition, children in 2 trials provided no answer); in all other trials, an expression was selected for the *pax* label. For the free-labeling task, 42% of children labeled the novel expression with the novel label.

For the choice-from-array task, a 3 (age group) x 2 (gender) x 3 (emotion label) mixed-design repeated measures ANOVA found that children’s performance increased with age,  $F(2, 18) = 5.41, p = .02, \eta_p^2 = .38$ . Four-year-olds’ performance was greater than that of two-year-olds ( $p = .004$ ), but was not different from that of three-year-olds ( $p = .15$ ). Single sample t-tests indicated that two-year-olds’ performance was not greater than the 33% that would be expected by chance guessing,  $t(7) = .36, p < .72$ , whereas performance of three-year-olds,  $t(7) = 5.27, p = .001$ , and four-year-olds,  $t(7) = 3.66, p = .007$ , was greater than chance. In addition, a main effect of emotion emerged; children

were more likely to match the expected label with the expressions of happiness and sadness than with the novel expression  $F(2,36) = 6.05, p = .005, \eta_p^2 = .25$  (all  $p$ s < .05).

For the free-labeling task, a 3 (age group) x 2 (gender) x 3 (expression) mixed-design repeated measures ANOVA showed that children's labeling of the expressions increased with age,  $F(2, 18) = 5.44, p = .02, \eta_p^2 = .37$ . Children were more likely to label the happy and sad expressions with the expected label than the novel expression  $F(2,36) = 5.25, p = .009, \eta_p^2 = .23$  (all  $p$ 's < .008).

## **Discussion**

The results of this study replicated those in Studies 1 and 2. In the choice-from-array task, the percentage of children matching the made-up expression with the made-up label was high. Although children were less likely to match the expected label with the novel expression than the happy or sad expressions, 67% still 'recognized' the pax face as *pax*. In addition, after only a few exposures to the novel label, 42% of children (including 75% of four-year-olds) freely labeled the novel expression as *pax*; children again appeared to 'recognize' the emotion presented. These data show that the results of the prior studies presented here were not due to children's ignorance of the response option "none" in the choice-from-array task; children continued to match the novel label with the novel expression even after they were made explicitly aware that the response "no" was sometimes the correct response in the task.

## **Study 4**

It is possible that children relied on a strategy of matching the novel label with the novel expression in the previous studies because the novel expression used was not an

emotional one, but rather, an arbitrary facial gesture. Children may have treated the expression as they would any other non-emotional object. To determine whether children would match a novel label to a novel *emotional* expression, we replicated Study 1 using as the novel facial expression an expression of contempt. We chose this expression because it has been associated with an emotion (Ekman & Friesen, 1986), but is relatively unknown to young children (Izard, 1971).

### **Method**

The method was identical to that of Study 3 (that is, again animal priming was used to emphasize that ‘no’ was a possible option), with the following exceptions.

**Participants.** The ages of participants were: two-year-olds ( $M = 31.3$  mos.,  $SD = 3.3$  mos.), three-year-olds ( $M = 40.3$  mos.,  $SD = 3.4$  mos.), and four-year-olds ( $M = 52.1$  mos.,  $SD = 3.0$  mos.).

**Materials.** We selected expressions of happiness, sadness, and contempt posed by one female (poser #31) and one male (poser #10) from the Radboud Faces Database (RaDF) (Langner, Dotsch, Bijlstra, Wigboldus, Hawk, & van Knippenberg, 2010). All posers were facing straight ahead and were looking forward.

**Scoring.** For the free labeling task, responses scored as correct for an emotion category, in addition to those categorized in the previous studies, were: for happiness: *good*.

### **Results**

As shown in Table 1, the mean recognition score for preschoolers’ matching of the novel label and the novel expression was .88. This percentage is significantly greater

than the .33 that would be expected by chance guessing,  $t(23) = 10.04, p < .001$ . Each child had two opportunities to respond that no one in the array felt *pax*. For none of these 48 trials did children respond in such a way, although in 3 trials children provided no answer; all other children selected an expression from the array for the *pax* label. For the free-labeling task, 46% of children labeled the novel expression with the novel label.

For the choice-from-array task, a 3 (age group) x 2 (gender) x 3 (emotion label) mixed-design repeated measures ANOVA found that children's performance increased with age,  $F(2, 18) = 4.50, p = .03, \eta_p^2 = .33$ . Four-year-olds' performance was higher than that of two- or three-year-olds' (all  $p$ 's  $< .04$ ). Single sample t-tests indicated that the performance of all age groups was greater than the 33% that would be expected by chance guessing (all  $p$ 's  $< .02$ ). The main effect of age was qualified by an age x emotion interaction,  $F(4, 36) = 3.28, p = .02, \eta_p^2 = .26$ ; two-year-olds were more likely to match the expected label with the happy expression than the sad or novel expression (all  $ps < .001$ ). However, there were no differences across emotion for the other age groups (all  $ps > .47$ ) (Table 1).

For the free-labeling task, a 3 (age group) x 2 (gender) x 3 (expression) mixed-design repeated measures ANOVA showed that children's labeling of the expressions increased with age,  $F(2, 18) = 7.86, p = .004, \eta_p^2 = .47$ . Four-year-olds' labeling of the expressions was higher than that of two- and three-year-olds ( $ps = .009, .001$ , respectively). Children were also less likely to label to the *pax* expression with the expected label than the happy or sad expressions  $F(2, 36) = 4.86, p = .01, \eta_p^2 = .21$  (all  $p$ 's  $< .03$ ).



## Discussion

As in the studies presented earlier, the percentage of children matching the made-up expression with the made-up label in the choice-from-array task was high and similar to that of other emotions; children were as likely to ‘recognize’ the *pax* face as they were to ‘recognize’ the sad face. In addition, after only a few exposures to the novel label, 46% of children (including 75% of four-year-olds) freely labeled the novel expression as *pax*. Children again appeared to ‘recognize’ the emotion presented. These data indicate that results of the previous studies presented here were not due to children’s matching of novel labels with non-emotional or arbitrary expressions – children also match novel labels with novel emotional expressions.

### Study 5

It is possible that children matched novel expressions with novel labels in the studies presented earlier because they recognized that both were unusual or made-up and therefore must go together. However, children may be less likely to match a novel expression with a familiar label that refers to an emotion they have likely experienced and have seen displayed by others. For example, research has shown that children as young as two years of age have likely experienced the emotion of pride (Jennings, 2004; Stipek, 1995). In addition, some have claimed that a majority of four-year-olds recognize expressions of pride when presented in a choice-from-array task (Tracy, Robins & Lagattuta, 2005). These studies suggest that preschoolers are familiar with the label and experience of pride and have matched the label pride to an expected expression in prior

research. Therefore, I replicated Study 1 and, rather than presenting children with a novel label, presented them with the label *proud*.

## **Method**

The method was identical to that of Study 1 and incorporated the Animal Priming task used in Study 3. In addition, the method included the following variations from that of Study 1.

**Participants.** The ages of participants were: two-year-olds ( $M = 31.1$  mos.,  $SD = 3.6$  mos.), three-year-olds ( $M = 42.8$  mos.,  $SD = 2.7$  mos.), and four-year-olds ( $M = 55.0$  mos.,  $SD = 3.6$  mos.). In addition, an adult comparison group ( $N = 29$ ) evaluated materials for this study.

**Procedure.** Children were primed using the label *proud* instead of *sad*, and instead of being asked if anyone felt *pax*, children were asked “Do you see anyone who feels *proud*?” In addition, the Animal Labeling portion of the procedure from Study 3 was used. Finally, after freely labeling each expression, children freely labeled the emotion of the protagonist in a story intended to convey pride.

**Free Labeling Story Task.** As a final trial, children freely labeled a single emotional story. Children were shown a picture from the story (a bicycle next to a garage) and the experimenter read aloud the following: “One day, Jane's bicycle wouldn't work, and she'd never fixed a bicycle before. She tried to fix it, and finally figured out what the problem was. After she fixed her bicycle her dad said, "great job, I am so impressed!" Jane stood up very tall and felt like she could fix anything.” Children were

then asked to answer the question “How did she feel?” As expected, 90% of adults freely labeled the story protagonists’ emotion as *proud*.

**Scoring.** For the free labeling task, responses scored as correct for an emotion category, in addition to those categorized in prior studies were: for anger: *grumpy*; for proud: *proud*; and for surprise: *surprised*.

## Results

As shown in Table 1, the mean recognition score for preschoolers’ matching of the label *proud* to the novel expression was .79. This percentage is significantly greater than the .33 that would be expected by chance guessing,  $t(23) = 6.92, p < .001$ . Each child had two opportunities to respond that no one in the array felt *proud*. For only one of these 48 trials did a child respond in such a way; in all other trials an expression was selected for the *proud* label. For the free-labeling task, 42% of children labeled the novel expression as *proud*.

For the choice-from-array task, a 3 (age group) x 2 (gender) x 3 (emotion label) mixed-design repeated measures ANOVA found no main effects or interactions for any of these variables; children’s performance for the happiness, sadness and novel expressions did not vary,  $F(2, 36) = 1.41, p = .26$ .

For the free-labeling task, a 3 (age group) x 2 (gender) x 3 (expression) mixed-design repeated measures ANOVA found that children were less likely to match the expected label to the novel expression than the happy or sad expressions,  $F(2, 36) = 12.41, p < .001, \eta_p^2 = .41$  (all  $p$ ’s  $< .001$ ). In addition, an emotion x gender interaction found that female participants were less likely to match the expected label to the novel

expression than either the happy or sad expressions  $F(2, 36) = 3.68, p < .04, \eta_p^2 = .17$  (all  $p$ 's  $< .001$ ) whereas male participants showed no difference across emotions.

Despite children's strong association of the label *proud* with the novel expression in the choice-from-array and free labeling tasks, in the story labeling task only 5% of children labeled the protagonists' emotion as *proud* (Table 3). Children were more likely to label the story as *happy* (63%), a finding that suggests that, for preschoolers, the concepts of pride and happiness are not clearly differentiated.

## **Discussion**

The results of this study replicated those of the previously presented studies. In the choice-from-array task, children's performance matching known emotion labels to their associated expressions was indistinguishable from their matching of the made-up expression with the label *proud*. Children were as likely to 'recognize' the pax face as proud as they were to 'recognize' the sad face as sad. In this study, 79% of children matched the novel expression with the label *proud* in the choice-from-array task, a percentage similar to the 65% of 4-year-olds matching a pride expression with the label *proud* in previous research (Tracy, Robins & Lagattuta, 2005). That a similar percentage of children matched the label *pride* with both a made-up expression and one hypothesized to represent pride, suggests that claims that preschoolers recognize expressions of pride should be interpreted cautiously.

In addition, after only a few exposures to the label, 42% of children (including 50% of four-year-olds) freely labeled the novel expression as *proud*. Children appeared to 'recognize' the expression as *proud*, even though they were unfamiliar with the

expression and were unable to label a story depicting a pride situation. These findings are similar to those in the previously presented studies, suggesting that children were not simply matching unusual or made-up labels and expressions together – in this study children matched the familiar label *proud* with a novel expression.

### **Study 6**

It is possible that children matched novel expressions with the label *proud* in Study 5 because they were not familiar enough with the concept of pride. Although *proud* is surely a word children hear within their first few years, pride may not be a concept young children encounter often. However, the emotion of fear is among the most common emotion labels used by preschoolers, as illustrated in the CHILDES database (Wellman, Harris, Banerjee & Sinclair, 1995). In addition, as discussed earlier, prior research has shown that preschoolers associate the emotion of fear with expressions intended to convey fear (Izard, 1971; Markham & Adams, 1992; Wiggers & van Lieshout, 1985), as well as with stories depicting fearful situations (Boyatzis, Chazan & Ting, 1993; Camras & Allison; Widen & Russell, 2002; Wiggers & van Lieshout, 1985). Taken together, these studies suggest that preschoolers are familiar with many aspects of the concept of fear including the associated label, expression, and situations. Therefore, I replicated Study 5 and rather than presenting children the label *pride*, presented them with the emotion label of *fear*. If preschoolers are presented with a label as familiar as *fear*, perhaps they will not match this label to a novel, made-up expression.

### **Method**

The method was identical to that of Study 5 with the following exceptions.

**Participants.** The ages of participants were: two-year-olds ( $M = 32.9$  mos.,  $SD = 2.4$  mos.), three-year-olds ( $M = 42.3$  mos.,  $SD = 3.0$  mos.), and four-year-olds ( $M = 53.5$  mos.,  $SD = 2.6$  mos.). In addition, an adult comparison group ( $N = 29$ ) evaluated materials for this study.

**Procedure.** Children were primed using the label *scared* instead of *proud*, and instead of being asked if anyone felt *proud* children were asked “Do you see anyone who feels *scared*?” In addition, after freely labeling each expression, children labeled the emotion of a story protagonist in a story intended to convey fear.

**Free Labeling Story Task.** Children were shown a picture from the story (a dark bedroom with an open closet door) and the experimenter read aloud the following: “One day, Jane was sleeping in her bed. Then something woke her up. Her room was dark, and she was all alone. Something was moving in her closet: She thought it was a monster. She screamed and pulled the covers up over her head.” Children were then asked to answer the question “How did she feel?” As expected, 93% of the adult comparison group freely labeled the story protagonists’ emotion as *scared*.

**Scoring.** For the free labeling task, responses scored as correct, in addition to those categorized in previous studies, were: for fear: *scared*.

## Results

As shown in Table 1, the mean recognition score for preschoolers’ matching of the label *scared* and the novel expression was .77. This percentage is significantly greater than the .33 that would be expected by chance guessing,  $t(23) = 6.56, p < .001$ . Each child had two opportunities to respond that no one in the array felt *scared*. In only

three of these 48 trials did children respond in such a way; in all other trials an expression was selected for the *scared* label. For the free-labeling task, 63% of children labeled the novel expression as *scared*.

For the choice-from-array task, a 3 (age group) x 2 (gender) x 3 (emotion label) mixed-design repeated measures ANOVA found that children were more likely to match the expected label with the expressions of happiness than they were to match the label *fear* with the novel expression,  $F(2, 36) = 4.19, p = .02, \eta_p^2 = .19 (p < .002)$ . However, there were no differences between children's matching of *fear* with the novel expression and their matching of *sad* with the sad expression ( $p = .16$ ) (Table 2).

For the free-labeling task, a 3 (age group) x 2 (gender) x 3 (expression) mixed-design repeated measures ANOVA found that children were more likely to match the expected label to the happy expression than to either the sad or novel expressions  $F(2, 36) = 3.29, p = .05, \eta_p^2 = .16$  (all  $p$ 's  $< .03$ ).

The majority of children (50%) labeled the story protagonists' emotion as *scared*. As shown in Table 3, none of the two-year-olds labeled the story scared, but 63% of 3-year-olds and 88% of four-year-olds did so. These data indicate that the older preschoolers were familiar with the concept of fear. That children matched the label *scared* to an expression they were unfamiliar with was not due to their failure to understand the emotion of fear or the associated label.

## Discussion

As in Study 5, the percentage of children matching the made-up expression with the label *scared* in the choice-from-array task was high and similar to that of other

emotions. Children were as likely to ‘recognize’ the puffed-cheeks face as scared as they were to ‘recognize’ the sad face as sad. In this study, 77% of children matched the novel expression with the label *scared* in the choice-from-array task, a percentage similar to the 62% of preschoolers matching a fear expression with the label *scared* in previous research (Izard, 1971). That a similar percentage of children matched the label *scared* with both a made-up expression and one hypothesized to represent fear, calls into question previous claims that preschoolers recognize expressions of fear.

In addition, after only a few exposures to the novel label, 63% of children (including 88% of four-year-olds) freely labeled the novel expression as *scared*. Children again appeared to ‘recognize’ the emotion presented, even though they demonstrated an understanding of a story depicting a fearful situation. These findings are similar to those in the previously presented studies and suggest that children were not simply matching labels with novel expressions because they were unfamiliar with the concepts related to the label or because the emotion category in question was not basic – in this study children matched the basic emotion label *scared* with a novel expression.

### **Conclusion**

In the last 40 years, research on children’s understanding of facial expressions has found that children reliably select the fear face when asked to find someone who is fearful. Researchers concluded that children “recognized” the fear in the fear face. However, as shown in Table 1, across the six studies presented we found that 80% of the 144 children tested also selected a novel expression when presented with a label that did not apply to the other expressions in the array, whether that label was novel (*pax*, *tolen*)



or familiar (*fear, pride*). Children “recognized” the pax in the pax face. Across the six studies presented, children’s matching of the expected label and the novel expression was robust and was not contingent upon the expressions presented in the array, the saliency of the response option “none”, whether the novel expression was emotional or not, whether the label presented was an emotion word or not, or whether children were familiar with the concepts conveyed by the target label. These data call into question prior research using choice-from-array tasks and the subsequent claims made that children recognize emotional expressions. In the choice-from-array task, children can appear to ‘recognize’ expressions by relying on the process of elimination rather than their interpretation of the expression. The studies presented here suggest that tasks employing language-based measures may overestimate children’s knowledge; claims of expression recognition might more usefully be tested using behavioral or physiological measures.

In addition, as shown in Table 1, after just two choice-from-array trials, nearly half of the 144 children in these studies (including 73% of four-year-olds) went on to spontaneously label the novel expression with the expected label. These data suggest that the choice-from-array task can teach children to associate specific expressions and labels even after only a few trials. Prior research has used many choice-from-array trials (e.g.: 39 trials in Izard, 1971) and presented choice-from-array trials before free labeling trials (Harrigan, 1984; Izard, 1971; Markham & Adams, 1992; Walden & Field, 1982). It is possible that in prior research, children created associations between labels and expressions during the choice-from-array task that did not exist before they participated

in the study -- associations that could have influenced their performance in the subsequent free labeling task.

As there was no prior association between the novel expressions presented and the labels children matched to them, it is likely that children used a process of elimination to make this association. These data are the first to show that children apply this strategy to facial expressions. Children as young as two years of age have been shown to associate the expressions of happiness, sadness and anger with the expected labels (Denham & Couchoud, 1990; Widen & Russell, 2003), and few children in the studies presented here matched the label *pax* or *fear* with these known expressions. Rather, the data are consistent with the idea that when children were presented with the label *pax*, *pride*, or *fear* in the choice-from-array tasks, they matched it to the expression for which they did not already have a label. These data are also consistent with the idea that children learned emotion labels using the process of elimination, as evidenced by the nearly half of children who spontaneously labeled the novel expression with the expected label in the subsequent free labeling task.

Even when not matching the novel expression with the novel label, children may still have employed a process of elimination strategy in their responding. Indeed this was the case: of the 20% of children who did not match each of the expected expressions and labels in the task, 65% of these still employed a process of elimination, choosing a different face for each of the three labels presented by the experimenter. These data indicate that preschoolers consider, not just the expressions presented in an emotion recognition task, but also the context within which the expressions are presented and can

appear to recognize an emotion even when they are unfamiliar with the expression or the label.

As may be expected, the six studies presented here have several limitations. One limitation is that the number of expressions presented in the array was small. Although presenting young children arrays of three expressions is common in the literature, some could argue that in the studies presented here three expressions in the array would have made the novel expression too obvious and the task too easy. This is certainly a valid concern and preliminary data collected in our lab may shed some light on this issue; in a study in which 5- and 6-year-olds matched labels to expressions in an array of five expressions (happiness, sadness, anger, surprise and the puffed-cheeks), 63% of children in this study matched the novel label (*pax* or *tolen*) with the novel expression. These data indicate that children continue to use the process of elimination to match novel labels and expressions in a larger array, although children's performance was lower than the 80% seen in the studies presented here. This drop in performance may be related to increased cognitive demands of the additional expressions in the array, changes in levels of chance guessing, or some other cause – a question that can be answered with further research.

Another limitation of these studies is that the only young children were tested and the response patterns of preschoolers, who are still acquiring knowledge about emotions, are not representative of all children or adults. Preschoolers may simply have assumed that the novel expression and label were conventional emotional items because they were presented by the experimenter, whereas older children or adults are more familiar with emotional expressions and less likely to attribute an emotion (whether *fear* or *pax*) to a

novel expression. This is an important point, and, again, preliminary data from our lab may begin to address some of these concerns; in a study in which 9- and 10-year-olds matched labels to expressions in an array of five expressions, 70% matched the novel label with the novel expression. However, adults, when presented a similar task, were unwilling to match a novel label and expression (only 30% do so), many indicating that the label and the expression were unfamiliar. These data suggest that people may learn about facial expression categories and their associated labels into late childhood, but by adulthood are aware of which expressions and labels are commonly used to convey emotions.

Another limitation of these studies is the use of only one kind of task; the problems present in a choice-from-array task do not necessarily generalize to other tasks. Prior research using tasks such as asking children to select an emotion word from a list that best describes the expression (e.g.: Camras & Allison, 1985; Reichenbach & Masters, 1983; Wiggers & van Lieshout, 1985) or asking them to match emotional stories to expressions (e.g.: Camras & Allison, 1985; Denham & Couchoud, 1990; Markham & Adams, 1992) may not be susceptible to a process of elimination strategy. However, data collected in our lab using a task in which 2-4 year-olds were asked to select a word from a verbally presented list that best describes an expression found that 84.5% of 3- and 4-year-olds match a novel label with a novel expression. In addition, preliminary data in which preschoolers were asked to match an emotional story (describing happiness, sadness, or fear) to an expression in array of three expressions (happy, sad and puffed-cheeks) suggests that 3-year-olds match the fear story with the novel puffed-cheeks

expression. Taken together, these studies suggest that preschoolers employ a process of elimination strategy to match emotional expressions and labels across a variety of emotion recognition tasks and I suspect that any ‘forced-choice’ task (i.e. those in which a child must choose between a set of options, whether they are expressions, stories, or labels) encourages the use of this strategy.

Proponents of the basic emotions theory might also point out that the methods used in the studies presented here differ in some ways from the methods used in prior research using choice-from-array tasks. For example, in the studies presented here, children were asked to select three emotions from an array of three expressions, were presented expressions posed by only two posers, and were presented the labels in a structured order for each array (the novel expression was always last in Array 1 and second in Array 2). Alternatively, in some prior research, children were asked to select only one emotion from an array of three expressions (e.g.: Harrigan, 1984; Izard, 1971; Tracy et al, 2005), were presented expressions posed by several posers (e.g. Bullock & Russell, 1984, 1985; Gagnon et al, 2010; Izard, 1971), and were presented the labels in a random order (Denham & Couchoud, 1990; Izard, 1971; Harrigan, 1994). Each of these methodological differences may influence the likelihood that children will use a process of elimination strategy, a question that can be answered with future research. However, the percentage of preschoolers matching the novel expression and the target label in the studies presented here was generally higher than the percentage of preschoolers matching emotional expressions and their associated labels in prior research. For example, 63% of children matched the expression with the expected label in previous research when the

array included three expressions, whereas 80% of children in the studies presented here matched the novel expression with the expected label. If the use of methods more similar to those used in previous research decreases preschoolers' likelihood of matching a novel expression and a target label, it is possible that their performance would simply drop to be more similar to that of prior research. Unless performance were to decrease to levels lower than expected by chance guessing, these data would still be consistent with the idea that children in prior research could have used a process of elimination strategy to appear to 'recognize' expressions.

Finally, some might argue that children's matching of a novel expression and a target label not previously associated with that expression is entirely due to the task demands placed on children and does not truly reflect their reasoning about emotional expressions. Relatedly, some might argue that the task presented here, in which an expression not intended to convey an emotion was presented as emotional, is a situation children are unlikely to encounter and that, in general, their emotion matching skills are well represented by the choice-from-array task. While I agree that the choice-from-array task can place demands on participants (child or adult) and cause them to respond in ways they would not do spontaneously, I do not agree with the supposition that this concern applies only to 'fake' rather than 'real' expressions. Children are unlikely to be equally familiar with all expressions presented in prior research (young children may be witness expressions of fear or contempt as less often than they witness expressions of happiness, for example). Therefore, some of the expressions presented in prior choice-from-array tasks were likely unfamiliar to children; arrays that contain unfamiliar

expressions would be similar to the arrays presented here. If children are subject to task demands when presented an unfamiliar expression in a choice-from-array task (as well as tasks matching labels or stories to expressions, as discussed previously), the findings and conclusions of previous research must be interpreted cautiously. Previous findings could be inflated or even primarily driven by the demands of the task and children's use of the process of elimination, as was the case for children's recognition of 'pax'.

The research presented here may provide insight into the process by which children acquire knowledge about emotional expressions. At some point in the life span, presumably, all expressions are novel for children and none have a known label. The idea that children, once they are familiar with one expression and its label, would use a process of elimination to match other expressions with other labels is consistent with a great deal of literature documenting children's use of this strategy in a variety of other situations. The studies presented here suggest that children learn about a wider variety of expressions than just those hypothesized to represent 'basic' emotions; children clearly learn about expressions like happiness and sadness, but also about expressions like pax.

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Table 1. Percentage of children, by age, in each study matching the target label with the novel expression.

	Study 1	Study 2	Study 3	Study 4	Study 5	Study 6	Mean
Choice-From-Array Task							
Two-year-olds	81	75	38	69	68	68	67
Three-year-olds	100	75	81	94	88	75	86
Four-year-olds	94	94	81	100	81	88	90
Mean	92	81	67	88	79	77	80
Free Labeling Task							
Two-year-olds	13	25	13	13	25	38	21
Three-year-olds	38	38	38	50	50	63	46
Four-year-olds	88	63	75	75	50	88	73
Mean	46	42	42	46	42	63	46

Note. In Studies 1-4, the target label was either *pax* or *tolen*. In Study 5, the target label was *proud*. In Study 6, the target label was *scared*.

Table 2. Percentage of children in each study who matched the expected label and expression, by emotion.

	Study 1	Study 2	Study 3	Study 4	Study 5	Study 6	Mean
Choice-From-Array Task							
Happy	94	90	92	90	88	96	91
Sad/Angry	90	92	81	98	88	85	89
Novel/Contempt	92	81	67	88	79	77	80
Mean	92	88	80	92	85	86	87
Free Labeling Task							
Happy	88	96	71	79	83	92	85
Sad/Angry	79	63	71	71	79	67	72
Novel/Contempt	46	42	42	46	42	63	46
Mean	71	67	61	65	68	74	68

Note. In Studies 1-4, the target label was either *pax* or *tolen*. In Study 5, the target label was *proud*. In Study 6, the target label was *scared*.



Table 3. Percentage of children, by age, in Studies 5 and 6 giving each label for the emotional story.

	Emotion Label					No Answer	Total
	Happy	Sad	Scared	Proud	Other		
Study 5 – Pride Story							
Two-year-olds	20					80	100
Three-year-olds	88					12	100
Four-year-olds	83			17			100
Mean	64			17		46	
Study 6 – Fear Story							
Two-year-olds	25	38			12	25	100
Three-year-olds		38	62				100
Four-year-olds		12	88				100
Mean	25	29	75		12	25	