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Preschoolers' use of dynamic facial, bodily, and vocal cues to emotion

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ABSTRACT

In daily experience, children have access to a variety of cues to others' emotions, including face, voice, and body posture. Determining which cues they use at which ages will help to reveal how the ability to recognize emotions develops. For happiness, sadness, anger, and fear, preschoolers (3–5 years, $N = 144$) were asked to label the emotion conveyed by dynamic cues in four cue conditions. The Face-only, Body Posture-only, and Multi-cue (face, body, and voice) conditions all were well recognized ($M > 70\%$). In the Voice-only condition, recognition of sadness was high (72%), but recognition of the three other emotions was significantly lower (34%).

Introduction

Children's ability to detect others' emotions has been suggested to influence many facets of their lives, including cognitive development and social competence (Denham et al., 2003; Garner & Waajid, 2008; Nowicki & Duke, 1992; Raver, Garner, & Smith-Donald, 2007; Trentacosta & Izard, 2007). However, much of this research has relied on children's attributions of emotion to facial expressions, whereas expressions in everyday life include several simultaneously displayed cues such as facial, postural, and vocal expressions. This nearly exclusive focus on children's understanding of facial expressions does not provide a complete picture of their understanding of others' emotion expressions.

Prior research has shown that although adults are most likely to attribute the expected emotion to an expression in which several cues are available (van de Riet & de Gelder, 2008; Van den Stock, Righart, & de Gelder, 2007), they are also able to do so when only a single cue is available. Adults attribute emotion to facial expressions (Darwin, 1872/1965; Izard, 1971; Schlosberg, 1954) and postural

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expressions (Coulson, 2004; Van den Stock, Grèzes, & de Gelder, 2008; Van den Stock, Peretz, Grézes, & de Gelder, 2009; Van den Stock et al., 2007), and prior research has shown adults to be equally proficient in attributing emotion to facial cues and postural cues (de Gelder, 2009; Rosenthal, Hall, DiMatteo, Rogers, & Archer, 1979). Adults have more difficulty in attributing the expected emotion to vocal intonation (Bänziger, Grandjean, & Scherer, 2009; Kreifelts, Ethofer, Grodd, Erb, & Wildgruber, 2007; Sauter & Eimer, 2010; Simon-Thomas, Keltner, Sauter, Sinicropi-Yao, & Abramson, 2009), although research with vocal bursts (e.g., exclamations of "yay" for happiness) has provided more promising results (Hawk, van Kleef, Fischer, & van der Schalk, 2009).

At what age do children use facial, postural, and vocal cues to attribute emotions to others? Two tasks, the Profile of Nonverbal Sensitivity (PONS) and the Diagnostic Analysis of Nonverbal Accuracy (DANVA), have been used to determine that elementary school-aged children attribute the expected emotion to facial expressions and postural expressions but, like adults, are less likely to attribute the expected emotion to vocal expressions (Nowicki & Duke, 1994; Rosenthal et al., 1979). However, neither of these tasks has been conducted with children younger than 7 years.

Facial, postural, and vocal cues are available to preschoolers during daily social interactions, but most research has focused only on children's understanding of facial expressions (Camras, Grow, & Ribordy, 1983; Denham et al., 2003; Widen & Russell, 2008). Although less well examined, preschoolers have also been shown to attribute the expected emotion to postural cues as presented in dance (Boone & Cunningham, 1998) and to distinguish between happy and sad vocal intonation (Morton & Trehub, 2001; Stifter & Fox, 1987). However, no study has determined which of these three cues preschoolers are best able to recognize or whether the presentation of several cues provides them with an advantage in emotion attribution, leaving our knowledge of how children come to understand emotion cues incomplete.

In the current research, we compared children's performance labeling several individual cues to emotion (facial, postural, and vocal), presented dynamically, with their performance labeling a combined presentation of these cues. The video clips were created for this study with the protagonist played by a professional female actor. In a within-subjects design, participants were shown three sets of video clips (Face-only, Body Posture-only, and Voice-only) in counterbalanced order, and then a fourth set of video clips (Multi-cue) was shown as a final trial. The multi-cue clips provided children with the most expression information and allowed us to compare their performance with these richer stimuli with their performance with the relatively impoverished individual cue clips. Children were asked to label the emotion of the protagonist (happiness, sadness, anger, or fear) in the video clip and were free to give any emotion label they chose. We chose this free-labeling format over a forced-choice format to examine children's spontaneous, rather than forced, interpretation of cues.

Method

Participants

Participants were 144 preschoolers, with 48 children in each of three age groups: 3-year-olds (M = 42.7 months, SD = 2.98), 4-year-olds (M = 53.6 months, SD = 3.13), and 5-year-olds (M = 64.8 months, SD = 2.96).[1] Each age group included an equal number of boys and girls. All children were fluent in English and were tested at child-care centers in the greater Boston area. In addition, 35 undergraduate students participated as an adult comparison group.

Materials

The video clips were of an approximate standard length (13 s) and featured a professional female actor who had more than 10 years of acting experience in theater and film. The actor displayed one of

[1] The ethnic composition of our sample was as follows: 69% Caucasian, 3.5% African American, 3.5% Hispanic, 3.5% Asian, 7.5% mixed race, 5% "other," and 8% of parents declined to provide their children's ethnicity. The average level of parental education for our sample was a bachelor's degree.

four target emotions: happiness, sadness, anger, or fear. In addition, a surprise video clip was used as a neutrally valenced training stimulus to introduce each set of video clips, and participants were not asked to label the emotion conveyed.

Face-only video clips

Each facial expression displayed by the actress was modeled after standardized expressions used in previous research (Ekman & Friesen, 1978). Only the actor's head and neck were visible, and she moved from a neutral expression to an emotional expression while speaking (although no sound was presented in the Face-only clip).

Body Posture-only video clips

The clip included the actor's head and body, but her face was obscured with a Gaussian blur throughout the clip. The actor was standing and moved from a neutral posture to an emotional posture (which she maintained throughout the expression). Each postural movement was modeled after postures used in prior research (Aviezer et al., 2008; Van den Stock et al., 2007) and included the following: expanded posture and arms raised over the head for happiness; slumped posture, lowered head, and arms at side for sadness; rigid posture leaning forward with fists clenched for anger; and rigid posture leaning back with arms raised defensively for fear.

Voice-only video clips

The vocal expressions were presented without visual information (i.e., a blank computer screen), and the actor's vocalization varied in intonation and pitch. The actor said the same neutral sentence in each of the videos: "I felt this feeling before; it was just a few days ago". This sentence was selected because it referred to the emotion experienced by the actor and provided her with sufficient time to emote.

Multi-cue video clips

For each emotion, the actor simultaneously displayed, in a realistic manner, all three emotion cues shown in the previous video clips: facial expression (moving from a neutral face to an emotional face), body posture (standing, moving from a neutral posture to an emotional posture), and vocal characteristics (varying intonation and pitch but saying the same neutral sentence for each video). The cues used in the multi-cue clip were identical to the cues used in the other clips.

Procedure

Priming

All children first underwent a priming procedure to make the needed emotion terms as accessible as possible. The experimenter initiated a conversation with the child about feelings, asking questions such as: "Happiness is a feeling; have you ever felt happy?" The labels targeted during the priming session were those that were to be presented in the study (happiness, sadness, anger, and fear), and all children who participated in the study heard each target emotion label twice before participating.

Introductory video clips

Children were first shown three introductory video clips of the actor performing normal daily activities in her house, displaying no emotion. Children were asked to label an easily recognizable household object held by the actor in the video clip (a book, an apple, or a hat) to ensure that they were able to produce labels in reference to the video clips when prompted.

Target trials

Next, the target video clips were presented as four separate blocks of trials: Face-only, Body Posture-only, Voice-only, and Multi-cue. Within each block, all four emotions were presented; order was determined by a Latin square design. Three blocks – Face-only, Body Posture-only, and Voice-only – were presented first in counterbalanced order, and then the Multi-cue block was presented last. All video clips were presented on a 12-in. computer screen, and children viewed 16 video clips in total.

Children were introduced to each block of trials with a training video clip appropriate for that block of video clips (Face-only, Body Posture-only, Voice-only, or Multi-cue) in which the actress displayed surprise. The training video clips provided an opportunity to familiarize children with each new cue type; children were not asked to label the training video clip, only to watch it. To introduce the emotion video clips, children were told a story about the protagonist "Molly," who finds in her living room a magical flower that "gives anyone who smells it a feeling." Children were told that Molly decided to smell the flower "to see how it would make her feel." The video clip was then played, and the actor approached the flower, smelled it, and produced an emotional expression.[2] Children were asked to answer the question "How did she feel?" and were free to give any emotion label they chose. Correct responses were scored as 1, and incorrect responses were scored as 0.

Adult comparison group

All video clips used in this study were initially tested with an adult comparison group ($N = 35$) to establish the emotional content of the stimuli. After viewing each clip, participants were asked, "How did she feel?" Participants were asked to use a single word, if possible, but were otherwise free to use any label they chose. As expected, the majority (70% or greater) of the adult participants chose the target label for all clips presented, with participant agreement as follows: happiness = 100%, sadness = 91%, anger = 94%, and fear = 74% for Face-only clips; happiness = 97%, sadness = 94%, anger = 97%, and fear = 89% for Body Posture-only clips; happiness = 91%, sadness = 97%, anger = 77%, and fear = 70% for Voice-only clips; and happiness = 100%, sadness = 100%, anger = 100%, and fear = 94% for Multi-cue clips. This high agreement indicates that adults inferred the emotion expected in the clips.

Scoring

Both the adult and child participants used a variety of labels to describe the emotions shown, and each word that did not directly correspond to the target label expected for the emotion categories presented (happy, sad, angry, or scared) was evaluated by three independent judges. Judges were asked to decide whether a term was a synonym for any one of eight emotion labels (*happy*, *sad*, *angry*, *scared*, *surprised*, *disgusted*, *proud*, or *contented*). Labels for which judges could not come to an agreement were categorized as "other". Emotion terms were accepted for use in this study only if all three judges were in agreement as to the emotional category of the given term. Terms accepted for the discrete emotion categories were as follows: *elated*, *excited*, *great*, *joyful*, *good*, and *overjoyed* for happiness; *depressed*, *dismal*, *sorrowful*, and *upset* for sadness; *aggressive*, *frustrated*, *grumpy*, *hostile*, *jealous*, *mad*, and *rage* for anger; and *afraid*, *frightened*, and *terrified* for fear.

Responses were also scored for valence (e.g., labeling a stimulus predicted to be sad as *happy* was coded as a label of incorrect valence, whereas labeling it as *angry* was coded as a label of correct valence). The label *surprise* was generated in 4.6% of children's responses. Because surprise is an emotion category with neither positive nor negative valence, these responses were not categorized as being of correct valence.

[2] It is possible that the flower situation in this study could have had a positive priming effect on the children, but this is unlikely. Children's labeling of happy stimuli was not at ceiling for any modality and was at levels similar to those found in prior research using these stimuli (Nelson & Russell, 2011), suggesting that children's labeling of happy stimuli was not inflated. In addition, as shown in Table 2, the label *happy* was rarely used for nonhappy stimuli; of the 2304 responses provided by children, this happened only 69 times (2.9% of responses), suggesting that the flower situation did not induce children to produce the label *happy* for inappropriate stimuli.

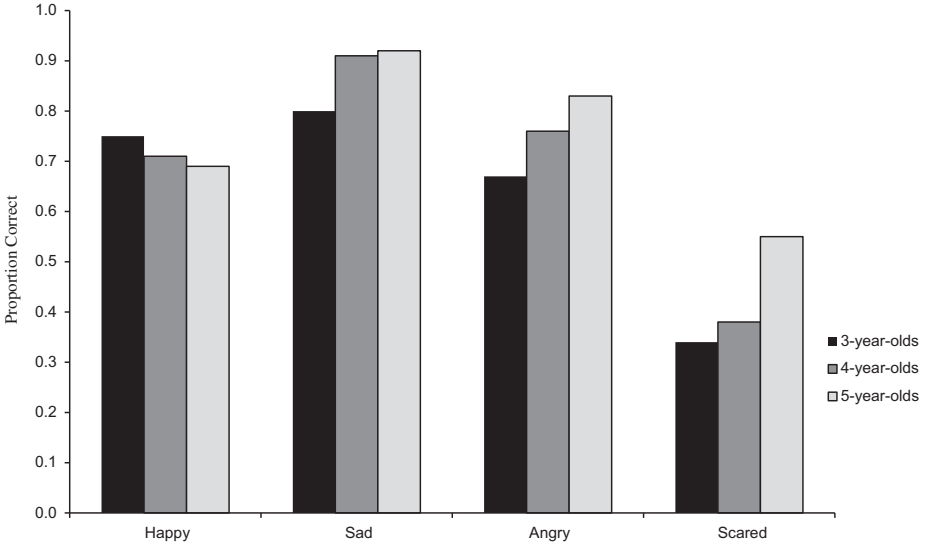

Fig. 1. Proportions of children's responses that were correct as to discrete emotion varied with age.

Results

Introductory video clips

Children had 3 × 144 = 432 opportunities to label the household objects shown in each of the three introductory video clips (a book, a hat, and an apple). Across all trials, 99.7% of children's responses were correct. Such a low incidence of mislabeling indicates that children's responses were not constrained by an inability to label the video clips.

Correct as to discrete category

A 2 (Gender) × 6 (Order of Condition) × 4 (Cue Type) × 4 (Emotion) mixed-design analysis of variance (ANOVA) showed no main effects or interactions involving gender or order of condition on children's labeling of cue type or emotion. Therefore, these factors were not included in further analysis.

A 4 (Cue Type) × 4 (Emotion) × 3 (Age) mixed-design ANOVA[3] showed that, as expected, children's correct labeling increased with age, $F(2, 141) = 5.943$, $p = .003$. Also as expected, children's correct labeling varied with the emotion presented, $F(3, 423) = 79.773$, $p < .001$. Bonferroni post hoc tests showed that children were more likely to correctly label the sad clips (all $ps < .001$), followed by happy and angry clips, which were not significantly different from each other, and finally the fear clips (all $ps < .001$). This pattern differed from that of adults, who were most likely to correctly label happy clips.

In addition, the emotion by age interaction, depicted in Fig. 1, showed that improvement with age varied with emotion such that improvement was greater for sad, angry, and scared than for happy, $F(6, 423) = 2.984$, $p = .007$. The minimal variance seen across age groups for labeling happy stimuli does not represent a ceiling effect; rather, it is indicative of the older children's greater likelihood of labeling these stimuli as *surprised* rather than *happy* (this was not observed in the adult comparison group).

Of particular interest to our hypothesis was the main effect of cue type, $F(3, 423) = 146.283$, $p < .001$, which was replicated for all age groups (Fig. 2). Children's performance labeling the Face-only

[3] Prior research has shown ANOVA techniques to be appropriate for use with binary data when cell frequencies are equal and the degrees of freedom of the error term are more than 40 (Lunney, 1970). These conditions were satisfied in this study (the degrees of freedom for the error terms ranged from 141 to 1269).

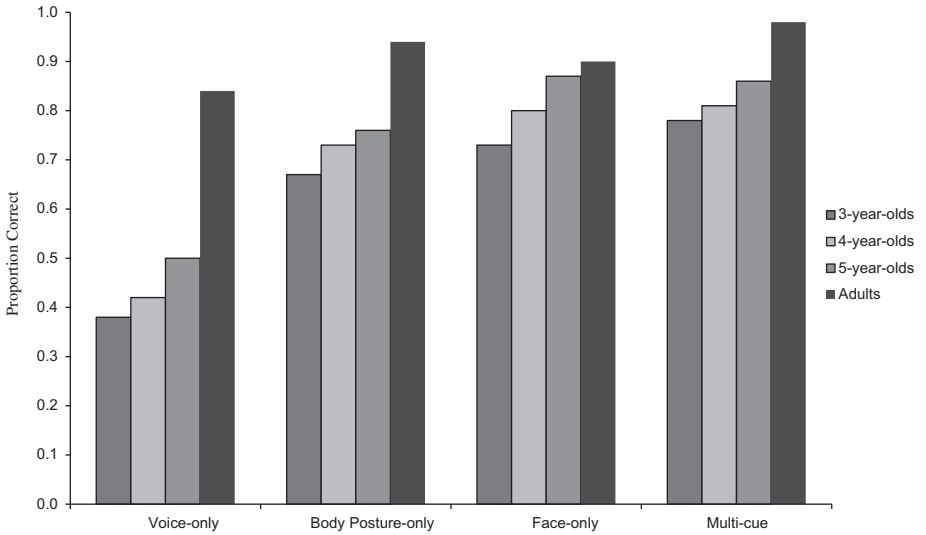

Fig. 2. Proportions of responses that were correct for each cue type for 3-, 4-, and 5-year-olds and the adult comparison group.

clips was higher than the Body Posture-only clips (*M*s = .80 and .72, respectively, $p < .001$), although children's performance labeling the Body Posture-only clips was still high. Labeling of the Voice-only clips was lowest ($M = .43$, all *p*s < .001), and the majority of children did not choose the target label for the stimuli presented. Finally, children's performance labeling the Multi-cue clips ($M = .81$) was not significantly different from the Face-only clips ($p = 1.00$) but was higher than that for the Body Posture-only and Voice-only clips (all *p*s < .001). Taken together, these findings indicate that although children were able to attribute the expected emotion to the facial and postural expressions, the presentation of these two cues in the same expression (i.e., the Multi-cue clips) did not increase their likelihood of attributing the expected emotion over the presentation of the facial expression alone.

The effect of cue type also varied with emotion, $F(9, 1269) = 6.674$, $p < .001$. We further explored this interaction using a series of one-way ANOVAs examining each cue type separately and investigating the effect of emotion for each cue (Table 1). All four analyses showed a significant effect of emotion: $F(3, 429) = 58.52$, $p < .001$, for Face-only clips; $F(3, 429) = 18.63$, $p < .001$, for Body Posture-only clips; $F(3, 429) = 41.86$, $p < .001$, for Voice-only clips; and $F(3, 429) = 44.256$, $p < .001$, for Multi-cue clips. For the Face-only, Body Posture-only, and Multi-cue clips, children were more likely to provide the target label for happy, sad, and angry clips than for fearful clips (all *p*s < .001). However, a different pattern emerged for the Voice-only clips, where children were most likely to provide the target label for sad voices, followed by angry voices, happy voices, and finally fearful voices (all *p*s < .01).

Table 1
Proportions of children's labels scored correct as to discrete emotion.

Emotion	Cue type				
	Face-only	Body Posture-only	Voice-only	Multi-cue	Mean
Happiness	$.89_a$	$.75_a$	$.33_a$	$.89_a$	.72
Sadness	$.95_a$	$.88_a$	$.72_b$	$.95_a$	.88
Anger	$.88_a$	$.74_a$	$.51_c$	$.88_a$	.75
Fear	$.50_b$	$.51_b$	$.17_d$	$.52_b$	.43
Mean	.81	.72	.43	.81	

Note. Maximum = 1.00. Bonferroni post hoc tests ($\alpha = .05$) were calculated on the means. Means in the same column that do not share a subscript differ at $p < .01$.

Table 2
Numbers of labels used by children for each emotion, by cue type.

	Cue type																Total
	Face-only				Body Posture-only				Voice-only				Multi-cue				
	Happy	Sad	Angry	Scared	Happy	Sad	Angry	Scared	Happy	Sad	Angry	Scared	Happy	Sad	Angry	Scared	
Happiness	**129**	1	1	2	**108**	4	15	12	**48**	7	15	6	**128**	1	3	2	482
Sadness	0	**137**	8	55	2	**127**	7	13	49	**103**	41	90	0	**137**	7	50	826
Anger	0	4	**126**	5	3	9	**106**	9	17	16	**73**	10	0	5	**128**	7	518
Fear	0	0	2	**69**	1	1	5	**74**	13	9	7	**25**	0	0	2	**76**	284
Surprise	15	0	0	3	26	0	5	23	10	3	2	7	14	0	0	5	113
Other	0	2	7	10	4	3	6	13	7	6	6	6	2	1	4	4	81
Total	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	

Note. $N = 144$. Correct discrete category responses are in bold.

Correct as to valence

When scored for valence, children's responses were generally correct with one exception. Most children provided labels of the correct valence for the Face-only clips ($M = .94$), Body Posture-only clips ($M = .81$), and Multi-cue clips ($M = .94$) (Table 2).[4] This was also the case when children labeled the Voice-only clips for sadness, anger, and fear ($M = .87$). However, far fewer children provided labels of correct valence for the Voice-only clip for happiness ($M = .33$); children were more likely to provide a label of negative valence than positive valence and were as likely to label the video clip *sad* ($M = .34$) as *happy* ($M = .33$). These results were in contrast with the performance of the adult comparison group, where a majority ($M = .91$) of the group selected the target label. These results indicate that children's responses, although considered as incorrect in terms of discrete labeling, were generally correct in terms of valence.[5]

Discussion

This research is the first to directly compare preschoolers' labeling of several components of emotion expressions. The discrete category results indicate that preschoolers were proficient in labeling the Face-only and Body Posture-only clips, whereas labeling of the Voice-only clips lagged behind. These findings suggest a developmental progression in which preschoolers first recognize the visual components of emotion expressions (facial and postural expressions) and only later come to recognize vocal expressions.

Children's performance labeling the voice stimuli was varied, although they were more likely to generate the expected label for the sad and angry clips. These results suggest that children first attribute discrete emotion categories to sad and angry intonation, even before happy and fearful intonation. In addition, children's tendency to label the happy voice with a term of negative valence, in contrast with adults' high performance in selecting the target label, indicates that children's differentiation of positive and negative intonation continues to develop after 5 years of age.

Children's performance labeling the Face-only expressions was similar to that for the Multi-cue expressions. This finding replicates prior research indicating that, unlike adults, preschoolers do not benefit from the presentation of several emotion cues over the presentation of a facial expression alone (Nelson & Russell, 2011). One possible interpretation of this finding is that preschoolers were using a featural process, rather than a holistic one, to analyze these expressions, meaning that they were less sensitive to the information provided by the additional cues presented. Prior research has found that children younger than 6 years tend to analyze faces featurally (Freire & Lee, 2001; Mondloch, Leis, & Maurer, 2006; Thompson & Massaro, 1989), whereas older children analyze expressions that include facial and postural cues holistically (Mondloch & Longfield, 2010). However, whether preschoolers tend to use a holistic process or featural process when analyzing expressions with facial and postural cues has not to our knowledge been tested.

Our results were examined in terms of valence, but children may have used other information in attributing emotion to the displays as well. In particular, the arousal of the postural and vocal expressions may have provided children with important information in making judgments of the emotion presented. For sadness, which was the only low-arousal emotion presented in this study, all clips, including the Body Posture-only and Voice-only clips, were well recognized. It is possible that children were sensitive to the low arousal of the display, thereby showing high rates of agreement. Whether arousal or another dimension is particularly important in children's understanding of emotion displays may be further clarified in future research.

[4] The majority of children's responses were coded as one of the four target emotions; the other categories generally had numbers too low to report. However, the category of surprise was an exception; a substantial number of children generated *surprise* labels. Because this information provides additional insight into children's responses, we included the category of surprise in Table 2 in addition to the target emotions.

[5] This study provided an opportunity to examine Widen and Russell's (2003) differentiation model using dynamic expressions. Children's responses were categorized as either fitting the pattern predicted by the differentiation model or not. Across all four clips, 84% of children's labeling patterns were predicted by the model, results that are in line with previous findings.

Due to concerns about inflated participant agreement with forced-choice formats (Russell, 1993), this study relied on a free label response format. With the free labeling procedure, children's high agreement is additionally convincing; these results provide insight into children's spontaneous emotion judgments and have not been artificially inflated by restricting their responses.

Conclusion

That preschoolers are more likely to attribute the expected label to facial or postural cues than to vocal cues is a finding that echoes previous research with older children and adults (Bänziger et al., 2009; Nowicki & Duke, 1994; Rosenthal et al., 1979). In this study, preschoolers' performance labeling the facial, postural, and vocal emotion cues did not vary by age within the preschool sample but was lower than adults' performance, suggesting that these skills develop gradually during the preschool years and continue to develop afterward. Finally, given that children's proficiency in recognizing postural expressions emerges in preschool (and is nearly as strong as facial expression recognition), this research illustrates compellingly that a narrow focus on facial expressions does not capture the true scope of preschoolers' emotion knowledge.

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