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Children's Decoding of Emotion in Expressive Body Movement: The Development of Cue Attunement

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Abstract

Relatively little research has focused on children's decoding of emotional meaning in expressive body movement and none has considered which movement cues children use to detect emotional meaning. The current study investigated the general ability to decode happiness, sadness, anger and fear in dance forms of expressive body movement and the specific ability to detect differences in the intensity of anger and happiness when the relative amount of movement cue specifying each emotion was systematically varied. Children ages four (N=25), five (N=25), eight (N=29), and adults (N=24) completed an emotion contrast task and two emotion intensity tasks. Decoding ability exceeding chance levels was demonstrated for sadness by four-year-olds; for sadness, fear, and happiness by five-year-olds; and for all emotions by eight-year-olds and adults. Children as young as five were shown to rely on emotion-specific movement cues in their decoding of anger and happiness intensity. The theoretical significance of effects associated with expressive body movement and emotion decoding across development is discussed.

Children's Decoding of Emotion in Expressive Body Movement: The Development of Cue Attunement

Given the importance of the nonverbal communication of emotion for development and general psychological well-being, it follows that the acquisition of skill in this domain needs to be fully understood. Buck (1984, 1991) argued that the communication of emotion includes a spontaneous component that is nonpropositional, involuntary, and expressive, and may include a symbolic component that is propositional, intentional, and referential. In describing the development of emotion decoding skills, Buck (1984) also distinguishes between emotion perception and emotion cognition. Emotion perception involves the extraction of emotional meaning from structural cues embedded within an expressive display in a direct perception process like that suggested by J. J. Gibson (1966). Emotion cognition encompasses the understanding of emotional experience based upon reflective processes such as knowledge of display rules, interpretation of behavior in context, or theory of mind issues. While both processes lead to an "attribution" of emotion, in emotion perception the child can make the attribution directly from the perceived stimulus cues without having to interpret or reflectively integrate information from additional sources.

Researchers interested in emotion cognition, which focuses more on the symbolic component of emotion communication, ask questions such as how well children cognitively understand emotional experience in complex events (Harris, 1993; Wintre & Vallance, 1994), whether children comprehend that one event can elicit more than one emotion (Harter & Buddin, 1987), and whether children use contextual cues or expressive cues to make emotional attributions (Boyatzis & Satyaprasad, 1994; Hortaçsu & Ekinci, 1992; Reichenbach & Masters, 1983). In contrast, researchers investigating emotion perception, which focuses more on the nonpropositional, spontaneous component of emotional communication, employ a more stimulus-driven approach. Such work is founded on theoretical accounts of information extraction (Brunswik, 1955; Gibson, 1982; Gibson, 1966) which emphasize the importance of specifying stimulus cues or structures which

convey meaning to the perceiver. Research in this area focuses on the identification and perception of structural cues embedded in the stimuli that are universally recognized to specify specific emotional states (Izard, 1991; Odom & Lemond, 1972), the order in which certain emotions are recognized (Izard, 1971; Stifter & Fox, 1987), and the effect of systematic cue manipulation (Walden & Field, 1982). According to Buck's developmental-interactionalist model (1984, 1988, 1991), emotion perception occurs as soon as the child learns to attend to the relevant stimulus cues and decode the specified emotion. Emotion cognition is thought to develop later, as the child gains more sophisticated cognitive skills, has more experience in social interactions, and begins to acquire culture-specific display rules.

Perception of emotion in the face and voice begins during the first year of life (Walker-Andrews, 1997). By four and five years of age most typically developing children can use verbal labels to identify discrete categories of emotional meaning conveyed by stimuli from various nonverbal channels, including the face (Bretherton, Fritz, Zahn-Waxler, & Ridgeway, 1986; Izard, 1971; Odom & Lemond, 1972; Reichenbach & Masters, 1983; Stifter & Fox, 1987; Walden & Field, 1982), voice/prosody (Berk, Doehring, & Bryans, 1983; Hortaçsu & Ekinci, 1992; Stifter & Fox, 1987), and, to a lesser extent, music (Cunningham & Sterling, 1988; Terwogt & Van Grinsven, 1988). However, research in one nonverbal channel, expressive body movement, has remained relatively neglected with respect to younger-aged populations (Boyatzis & Satyaprasad, 1994; Bull, 1983). While there have been several studies that have focused on school-aged children's ability to recognize emotion in expressive body movements (DePaulo & Rosenthal, 1979; Custrini & Feldman, 1989), only a few known studies have examined the ability of children younger than eight years of age (Boyatzis & Satyaprasad, 1994; Van Meel, Verburgh, & DeMeijer, 1993).

To date, most of the work in the adult literature on expressive body movement has focused on its use in a symbolic, propositional sense (Bull, 1983; Dittman, 1987). For example, the Profile of Nonverbal Sensitivity, the PONS, was designed with the intent of

examining a "body only" channel (Rosenthal, Hall, DiMatteo, Rogers, & Archer, 1979, DePaulo & Rosenthal, 1979), but given the test's focus on action-oriented behaviors in which the gestures used were related to a social script, such as giving directions to a lost child, it is arguably more a measure of a decoder's skill at reading propositional gestures. In fact, none of the enacted scripts in the PONS were attempts at directly encoding a specific emotion category. Rather, emotional categorization for each script was assessed in terms of dimensional ratings of positivity and dominance.

Given the use of propositional stimuli, it is not surprising that researchers have focused more on school-aged children who have been more fully exposed to display rules (Custrini & Feldman, 1988; DePaulo & Rosenthal, 1979; Gnepp & Hess, 1986; Saarni, 1979). By eight years of age, most children understand the basics of display rules, cognitively understand that an event can elicit more than one emotion, and use and rely more on contextual cues provided by vignettes to make emotion attributions (Hortaçsu & Ekinci, 1992; Reichenbach & Masters, 1983). Indeed, only recently has there been any attempt to test younger age groups for their ability to decode propositional gesture. To that end, Boyatzis and Satyaprasad (1994) demonstrated that children as young as four and five were able to decode nonverbal gestures, such as a raised hand to indicate stop, at greater than chance levels. However, while clearly indicative of a child's ability to understand the referential meaning in various emblematic nonverbal gestures, this study did not measure children's ability to decode emotional meaning based on structural cues embedded within the body movements.

In contrast, little attention has been paid to nonpropositional displays of gesture and movement cues which arise from naturalistic emotional expression in body movement. In effort to demonstrate the existence of critical stimulus cues in gait, Montepare and colleagues (Montepare, Goldstein, & Clausen, 1987; Montepare & Zebrowitz, 1988) have shown that adults decode discrete emotional meaning for various patterns of movement. For example, Montepare et al. (1988) found that angry gaits were associated with greater amount of heavyfootedness compared to happy, sad, and proud gaits and that sad gaits had

significantly less arm swing than happy, proud, or angry gaits. Focusing more on expressive patterns involving the entire body, several researchers have begun to examine the medium of dance relative to its ability to express emotional meaning (Arnoff, Woike, & Hyman, 1992; Boone & Cunningham, 1996; DeMeijer, 1989, 1991; Walk & Homan, 1984; Walk & Samuels, 1988). Expressive body movement encoded via the medium of dance can be distinguished from propositional movement patterns such as emblems and scripted behavioral actions in that the movement patterns are meant to be stylized and focused expressions of the subtler, naturalistic movement patterns associated with direct, spontaneous expressions of emotion. Indeed, given the lack of propositional emblems and scripted behavioral actions, dance may be ideally suited for investigating the constituent elements of naturalistic motion, such as force, velocity, timing, and spatial orientation, which may more directly indicate an expresser's emotional state (DeMeijer, 1989; see also Walbott, 1980 and Frijda, 1982).

To date, there has been only one study that has investigated the development of emotion perception with respect to expressive body movement as portrayed by dance (Van Meel, Verburgh, & DeMeijer, 1993). In that study, children, ages 5, 8, 10, and 12 years, were shown either live or videotaped performances of expressive movement performances and asked to make judgments related to emotion attribution using several different response formats. In one response format children described the performances in narrative form, while the other format required that children choose one of four verbal emotion labels which best matched each of the expressive movement performances. In both cases, the five-year-old children scored significantly below the older children in their ability to identify the appropriate emotional meaning. While the study did not specifically attempt to create an accuracy score to be compared to chance, the means reported suggested that five-year-old children were failing to exceed chance-level decoding of emotional meaning. The authors concluded that children must be at least eight-years-old before they begin to decode the emotional meaning of an expressive movement performance.

The failure of five-year-olds to recognize emotional meaning in the Van Meel et al. (1993) study is inconsistent with the previously cited ability of younger children to decode emotional meaning in other nonverbal channels (Berk et al., 1983; Bretherton et al., 1986; Cunningham & Sterling, 1988; Hortaçsu & Ekinci, 1992; Izard, 1971; Odom & Lemond, 1972; Reichenbach & Masters, 1983; Stifter & Fox, 1987; Terwogt & Van Grinsven, 1988; Walden & Field, 1982). One potential cause of the discrepancy is that the stimuli used in Van Meel et al. study did not fully incorporate body movement cues which express emotion. Some of the dance performances were created by having the dancers react to an imaginary situation or object by moving in one of four directions that were theoretically associated with a discrete emotional category. The association of vertical movement with sadness and happiness and horizontal movement with anger and fear is propositional in its basis. Other of their dance performances were more like scripted action-events, such as embracing and closure between two dancers to represent love. Rather than relying on overt propositional symbols and learned action-events, a more effective stimulus to test direct emotion perception should include dance patterns comprised of salient, naturalistic body movement cues which have been demonstrated to encode discrete categories of emotional meaning.

Recent research has identified several such specific cues which adults use in their attribution of emotion to expressive body movement (Boone & Cunningham, 1996; DeMeijer, 1989, 1991), but there has been no systematic effort to extend these findings to a developmental sample. DeMeijer (1989) showed that adults associate specific body movements with increases and decreases in quantitative ratings of specific emotion categories. To do this, he identified seven dichotomous cues relating to movement of the trunk and arms. He then had dancers enact 96 movement patterns derived from combinations of these seven dichotomous cues while decoders assessed each pattern by making quantitative ratings for twelve different emotion categories.[1] However, since DeMeijer's main goal was to show how specific movement patterns were associated with particular emotion attributions, he neither tested the interrater agreement levels obtained for

his stimuli per emotion nor claimed to have created dance movements that typified a specific emotion category. Later however, he was able to show that the greater number of cues specifying a discrete emotional category within a presentation of expressive body movement, the more likely adults were to decode the targeted emotion (DeMeijer, 1991).

In an effort to uncover stimulus cues in naturally generated dance expressions of discrete emotion, Boone and Cunningham (1996) analyzed the movement cues embedded within dance performances in which actors successfully expressed happiness, sadness, anger, and fear with greater than 90% interrater agreement. Using an adult sample and several of the cues identified by DeMeijer (1989, 1991), they were able to show that six specific cues --- frequency of upward arm movement, the duration of time arms were kept close to the body, the amount of muscle tension, the duration of time an individual leaned forward, the number of directional changes in face and torso, and the number of tempo changes an individual made in a given action sequence were used by adults to distinguish among the target emotions of happiness, sadness, anger, and fear with greater than 90% accuracy. Specifically, anger was discriminated from the other three emotions by a greater number of directional changes in face and torso and a greater number of tempo changes. When portraying anger, the actors turned rapidly back and forth and varied the tempo of their motions frequently. Happiness was discriminated from sadness and fear by a greater number of upward arm movements and a greater period of time with arms kept away from the torso. When portraying happiness, the actors repeatedly threw their hands above their heads and kept their arms outstretched. Sadness was discriminated from fear by having significantly longer periods of downward gaze and less muscle tension. When portraying sadness, the actors looked kept their heads down and were fairly slack in body tone. When portraying fear, the actors were more rigid in how they held their body and kept their heads up and alert. Boone and Cunningham (1996) also demonstrated that a systematic increase in frequency of upward arm movements, a cue associated with happiness, led to an attribution of more intense happiness and that a systematic increase in the number of

directional changes in face and torso, a cue associated with anger, led to an attribution of more intense anger.

Having identified structural cues that specify discrete emotions in adults, it was hypothesized in accord with Buck (1984, 1988, 1991) that once children perceive these critical stimulus cues, they too should be able to utilize these cues to identify the emotional meaning of expressive body movement performances at greater than chance levels. The next step in understanding the development of this skill is identifying when children will start to perceive the relevant cues. For example, Walden and Field (1982) demonstrated that errors in identifying emotional meaning in facial expression resulted from mistakes associated with improper utilization of cues located in different parts of the face. Other researchers, focusing on E. J. Gibson's (1982) model for the emergence of cue attunement, have argued for a connection between motoric production and perception (Bushnell & Boudreau, 1993; Lockman, 1990). Specifically, production and perception are thought to be linked through the child's ability to interact with the environment and make specific discriminations. The suggestion here is that motoric action is a necessary, if not sufficient precondition for perception of an emotion specifying cue involving that motoric action. Within this view, experience with specific behavioral actions that are dependent upon the child's strength or coordination act as developmental "brakes" to the acquisition of related perceptual cues (Lochman, 1990). Thus, once the child begins to produce certain behavioral actions, the child will then have access to perceptual cues associated with that action, which in turn can lead to effective cue utilization.

It is now possible to consider the specific case of the developmental acquisition of emotion decoding from expressive body movement. By the age of four, children should be able to produce voluntary movement patterns identified in previous research, including those associated with frequency of upward arm movements, duration of time spent with arms close to the body, duration of time an individual leaned forward, and possibly the intensity of muscle tension. Given this, it was predicted that children as young as four will be attuned to these cues and be able to make the appropriate emotion attributions relative to these cues.

While rudimentary voluntary control of frequency of directional changes in face and torso and number of tempo changes are also in the behavioral repertoire of the four-year-old child, the additional need for precise voluntary control with respect to timing and the concurrent inability to reproduce changing rhythmic patterns (Hargreaves, 1986) should act to limit or reduce the child's ability to recognize emotional meaning derived from these cues, in this case, anger, prior to the age of eight.

In the current study, participants were asked to identify which of two body movement displays expressed one of four target emotions, including happiness, sadness, anger, and fear. Given previous research investigating emotion perception via other nonverbal channels (Cunningham & Sterling, 1988; Hortaçsu & Ekinci, 1991; Izard, 1971; Reichenbach & Masters, 1983; Stifter & Fox, 1987; Walden & Field, 1982) and previous research examining decoding of expressive body movement (Boyatzis & Satyaprasad, 1994; Custrini & Feldman, 1989; DePaulo & Rosenthal, 1979; Van Meel et al., 1993), the current study focused on children at ages four, five, and eight and compared their performance with an adult control group. The emotion categories of happiness, sadness, anger, and fear were selected based upon previous research and evidence that children as young as four could use these verbal labels to identify other nonverbal stimuli (Cunningham & Sterling, 1988; Hortaçsu & Ekinci, 1991; Izard, 1971; Reichenbach & Masters, 1983; Stifter & Fox, 1987; Walden & Field, 1982).

Given the previous research involving preschooler's identification of emotion in facial expression, prosody, and music, it was hypothesized that the children in the 4 - 5 year age range would perform at greater-than-chance levels for all four emotions, but identification of happiness, sadness, and fear were expected to have higher levels of accuracy than identification of anger. This differential accuracy as a function of emotion category was anticipated based on differential cue attunement. Specifically, children as young as 4 and 5 years of age were likely to be able to perform motor actions associated with upward arm movements, arm closure, controlled muscle tension, and gaze focused downward, and were thus predicted to use these cues to accurately discriminate expressions

of happiness, sadness, and fear. However, due to underdeveloped skills related to the production of rhythm and a concordant lack of cue attunement to structural cues related to rhythm, such as abrupt changes the direction of face and torso, children at ages 4 and 5 were expected to demonstrate lower accuracy compared to 8-year-olds in the identification of angry presentations. Adults were expected to demonstrate better than chance identification across all four categories of emotion.

A second goal of this study was to explore children's use of the identified cues in the attribution of emotion. Two specific movement cues, frequency of upward arm movement and directional changes in the face and torso, were selected based on anticipated differences in the development of cue attunement. The frequency of upward arm movement, a cue associated with happiness, was selected because children as young as four are capable of engaging in this motoric activity, thus making this cue a likely candidate for early usage in emotion attribution. The directional changes in face and torso, a cue associated with anger, was selected because of its motoric complexity and the likelihood that its usage would emerge at a later point in development. Given previous research (Stifter & Fox, 1987) which has shown that preschoolers are capable of making basic intensity judgments (i.e. more or less) relative to emotion displays, the current study included a pair of tasks in which the child was asked to identify which of two movement displays more intensely portrayed a target emotion. Based upon anticipated age differences in motoric proficiency, it was predicted that children in the two youngest age groups would demonstrate attunement to the frequency of upward arm movement cue by rating expressive movement performances with a greater number of upward arm movements as more happy, while attunement to abrupt directional changes in face and torso, as measured by rating expressive movement performances with a greater number of directional changes in face and torso as more angry, would not emerge until 8 years of age.

Method

Participants

A total of 103 participants, from four age levels (25 four-year-olds, 13 females and 12 males, ranging from 2.83 to 4.67 years of age, $\underline{M}_{age}$=4.15 yrs; 25 five-year-olds, 12 females and 13 males, ranging from 4.75 to 5.88 years of age, $\underline{M}_{age}$ =5.05 yrs; 29 eight-year-olds, 16 females and 13 males, ranging from 8.0 to 9.75 years of age, $\underline{M}_{age}$ =8.58 yrs; and 24 adults, 12 females and 12 males, ranging from 17 to 22 years of age, $\underline{M}_{age}$ =18.79 yrs) were recruited to watch 18 pairs of expressive movement performances. Informed consent from adult subjects and from the parents or guardians of all child subjects from the three younger age groups were obtained prior to their participation. The four- and five-year-old groups were recruited through two suburban daycares/preschools. Both preschools had two groups separated by age into younger and older children, the great majority of which corresponded to the targeted ages of four and five years of age. Preschool children younger than 4 years and 9 months of age were placed in the four-year-old group, while preschool children above and including 4 years and 9 months of age were placed in the five-year-old group. The eight-year-old group was recruited through a suburban elementary school. The adult group was recruited from a university introductory psychology class and received course credit for their participation.

Stimuli

A total of 18 stimulus segment pairs were created through the use of digitized video computer technology. Each segment pair was a split-screen presentation of two segments developed and used in a previous study (Boone & Cunningham, 1996). In this previous research, two actors, one male and one female, were repeatedly videotaped while expressing one of the four target emotions of happiness, sadness, anger, and fear, through the medium of dance. A total of 42 segments, approximately 20 to 40 seconds in length, were then shown to a group of 40 adults, who categorized each segment into one of the same four target emotion categories. Results from this research showed very high levels of interrater agreement for each category of emotion, with an overall average interrater agreement of 96%

for each segment. However, because preschoolers have demonstrated optimal performance in tasks requiring identification of emotional meaning from facial expression when given a nonverbal binary choice rather than having to make open-ended verbal responses or selecting from among four verbal alternatives (Smiley & Huttenlocher, 1989), a binary choice response format was utilized.

Since the original segments were created by two performers, one male and one female, both segments within a given segment pair always included the same performer. All segment pairs were digitized and subjected to a process of digitized blurring and fading to eliminate facial information. The split-screen presentation, digitization, and blurring were accomplished using a Macintosh Quadra AV and the Adobe Premiere Software package. Segment pairs were recorded from the computer onto a VHS videotape and presented on a 14-inch TV monitor. The net result was a series of split-screen presentations of two faded figures in which it was possible to see the direction of motion and details of gross body movements, but impossible to see any detail from the interior of the face. It should be noted that the digitization process introduced some stroboscopic discontinuity to the general motion of the movements, but given that the effect was introduced to both split-screen segments, this effect should not have impacted differentially in favor of one presentation over another.

Emotion Contrast Task. The first 12 segment-pairs comprised the Emotion Contrast Task. Each segment pair consisted of two performances of differing emotional quality. For each pair, one emotion was considered the target emotion performance, while the other was considered the foil emotion performance. Each of the four target emotions of happiness, sadness, anger, and fear was shown three times, once with each of the other three emotion foils. Utilizing the results from Boone & Cunningham (1996), performances with high interrater agreement from each emotion category were selected for inclusion in this task. Segment pairs were presented in a randomized order and were counterbalanced for identity (and thus sex) of the performer. Finally, the correct segment across all twelve segment pairs was presented an equal number of times on the left and the right side of the

screen. Table 1 lists the original segments, their emotion category, and adult interrater agreement levels from Boone & Cunningham (1996).

Emotion Intensity Tasks. The remaining 6 segments comprised the two Emotion Intensity Tasks, an Angry Cue Manipulation Task and a Happy Cue Manipulation Task.[2] Both tasks were designed to test the impact of systematic manipulation of critical cues on the decoded intensity of anger and happiness, respectively. To create these segments, a single segment of a given targeted emotion category was selected and duplicated. A critical cue was then systematically manipulated by removing portions of the segment which contained high amounts of the critical cue in one of the duplicated segments, thus creating a segment with a low level of the critical cue, and by removing portions of the segment which contained low amounts of the critical cue in the remaining duplicated segment, thus creating a segment with a high level of the critical cue. Within each pair, both segments were subjected to the same number of alterations to insure that there was no systematic manipulation (e.g., detectable from discontinuities in movement in conjunction with the editing process) other than the presentation of the critical cue. The two altered, but originally matched segments were then combined via the split-screen format and subjected to the same blurring and fading process to eliminate facial information.

Thus, while the Emotion Contrast Task involved selecting a target emotion from two simultaneously presented segments of differing emotional quality, the Emotion Intensity Tasks involved selecting between two altered versions of the same segment within a single emotion category which performance more intensely conveyed the target emotion. In the Angry Cue Manipulation Task, three segment pairs were used to test the effect of the manipulation of the anger cue of changes in direction of face and torso and were created from angry segments. In the Happy Cue Manipulation Task, three segment pairs were used to test the effect of the manipulation of the happy cue of frequency of upward arm movements and were created from happy segments. Table 2 specifies the order of presentation, the original interrater agreement levels from Boone & Cunningham (1996), and the cue manipulated for each segment pair of these two tasks.

Procedure

For the Emotion Contrast Task, adult subjects were asked to indicate whether the figure on the left or the right was expressing a verbally labeled target emotion. For the Emotion Intensity Tasks, adult subjects were asked to indicate whether the figure on the left or the right was expressing "more" of a given target emotion. All adult subjects responded to the items on both the Emotion Contrast Task and the Emotion Intensity Task by circling their responses on the answer sheet provided.

The general instructions to the younger subjects remained the same, but their response format differed slightly. Child participants were seated close to the TV monitor and were asked to point to which of the two figures was expressing the target emotion in the Emotion Contrast Task ("Who's happy?") and to point to which of two figures was expressing more of the target emotion in the Emotion Intensity Tasks ("Who's more happy?"). Additionally, familiar emotion terms were used; specifically, "mad" was substituted for "angry" and "scared" was substituted for "fearful." All subjects in the study responded to each test item. Response time was not recorded, but each segment-pair was presented for 20 seconds. If the child did not select a side within the first 10 seconds, the experimenter prompted the child by repeating the question again. In the two instances in which child subjects did not respond to the second prompt, the videotape was rewound, the subject was shown that segment pair again. In both cases, the subject indicated their response by the time the second presentation of segment-pair concluded. To accommodate developmental differences in attention, the four- and five-year old subjects were tested in two separate sessions. Session one included the Emotion Contrast Task and session two included the Emotion Intensity Tasks. The eight-year-old subjects were tested in a single session.

Finally, to insure that each subject understood the both tasks, both adult and child subjects were exposed to two pre-tests involving color. Prior to beginning the Emotion Contrast task, participants were shown two rectangles presented side by side, one red and one blue, and asked to indicate which rectangle was red. Successful completion of this task

demonstrated that the subject understood that their task was to identify the target color from two simultaneously presented possibilities. Prior to starting the Emotion Intensity Task, participants were shown two rectangles presented side by side, one light blue and one dark blue, and asked to indicate which rectangle was more blue. Successful completion of this task demonstrated that the subject understood that their task was to identify the more intense stimulus from two simultaneously presented possibilities from the same basic color group. Adult subjects responded to this test verbally, while child subjects responded by pointing. All subjects responded correctly to pretest items. Additionally, the pre-tests were arranged so that the correct answer was on the right side for one test and the left side for the other, demonstrating that all subjects were free to indicate the left or right side of the screen.

Results

The overall goal of this study was to investigate the emergence of and developmental differences in the ability to identify emotional meaning in dance forms of expressive movement. To establish the ability to decode expressed emotional meaning in the contrast task and the ability to differentiate intensity as a function of cue presence in the intensity task, individual accuracy scores were averaged by age group on both tasks and compared to chance performance. To investigate differences in performance as a function of development and emotion category, these same individual accuracy scores were then subjected to analysis of variance which assessed group differences as a function of age and emotion. Additionally, all of the initial analyses were originally organized to explore gender differences; however, the lack of significant main effects or interaction effects associated with gender led to a reorganization of the data in which gender was not considered.

Emotion Contrast Task

An individual accuracy score was calculated for each subject for total overall accuracy on the Emotion Contrast Task. A point was given for each segment pair in which the target emotion was correctly identified, yielding a score with a range from 0 to 12 with a mean of 6 expected by chance. The average accuracy scores for the four-, five-, eight-year-olds and adults were 7.28, 8.20, 10.48, and 10.71, respectively. The accuracy scores of all

four age groups were then compared to chance performance (M=6.00) utilizing a one-tailed one-sample t-test with an α of .05. All four groups performed significantly above chance on this measure; four-year-olds, t(24)=3.34, p=.0014; five-year-olds, t(24)=6.74, p<.0001; eight-year-olds, t(28)=22.98, p<.0001; and adults, t(23)=21.32, p<.0001.

To understand more fully the relationship between the identification of emotional meaning in expressive body movements and development, separate accuracy scores were calculated for each emotion category. This yielded a total of four scores per subject, one for each emotion category of happiness, sadness, anger, and fear, each with a range of 0 to 3 and an expected chance mean of 1.5. Table 3 provides the descriptive statistics for each of these accuracy measures. These accuracy scores were entered in a 4(Age Group) X 4(Emotion Category) analysis of variance with repeated measures on the last factor. This analysis revealed a significant main effect for Age Group, F(3, 99)=36.94, p<.0001, and a significant main effect for Emotion Category, F(3, 297)=3.52, p=.016. These main effects were qualified by a significant interaction between Age Group and Emotion Category, F(9, 297)=2.03, p=.036. The effect of Age Group and Emotion Category are graphically depicted in Figure 1. A post hoc analysis, using the Tukey procedure as outlined by Stevens (1992), revealed the following age differences in accurate decoding of emotion: the four- and five-year-olds were significantly less accurate than the eight-year-olds and adults in the identification of happiness, the four-year-olds were significantly less accurate than the five-year-olds and adults and the five-year-olds and the adults were significantly less accurate than the eight-year-olds in the identification of sadness, the four- and five-year-olds were significantly less accurate than the eight-year-olds and adults in the identification of anger, and the four- and five-year-olds were significantly less accurate than the eight-year-olds and adults in the identification of fear.

Overall, these findings suggest that children as young as four years of age are able to identify emotional meaning in expressive body movement, but that the most significant growth in the ability to recognize emotional meaning occurs between the ages of five and eight. However, subsequent analyses in which each group's accuracy score per emotion

category was compared to chance performance revealed some subtler differences.[3] These analyses revealed that the five-year-olds performed better than chance in the identification of happiness, sadness, and fear, while the four-year-olds only exceeded chance in their identification of sadness. These differences in performance relative to chance suggest that relative to four-year-olds, five-year-olds are starting to show increasing skill in their ability to recognize emotional expression as evidenced by above chance accuracy in the identification of three of the target emotion categories. Both the eight-year-olds and the adults performed better than chance on all four categories of emotion and there is little difference between the groups in their ability to recognize each of the four emotion categories. The t-values and associated probabilities for all four age groups across all four emotion categories are also shown in Table 3.

Emotion Intensity Tasks

Separate individual accuracy scores were calculated for both the Anger Cue Manipulation Task and the Happy Cue Manipulation Task. Subjects received a point for each segment for which they indicated a greater intensity for the presentation that had a greater level of the critical cue. This yielded two scores, one for each measure, both with a range from 0 to 3 and expected chance mean of 1.5.

Angry Cue Manipulation Task. The average accuracy scores on the Anger Cue Manipulation Task for the four-, five-, eight-year-olds and adults were 1.60, 1.96, 2.59, and 2.67, respectively. The accuracy scores of all four age groups were then compared to chance performance utilizing a one-tailed one-sample t-test with an α of .05, as depicted in Table 4. The three older groups performed significantly above chance on this measure; five-year-olds, $t(24)=2.85$, $p=.0044$; eight-year-olds, $t(28)=7.53$, $p<.0001$; and adults, $t(23)=9.57$, $p<.0001$, but the four-year-olds did not, $t(24)=0.60$, $p=.2767$. To investigate differences in accuracy as a function of age, the total accuracy scores were entered into a oneway analysis of variance which found a main effect for age group, $F(3,99)=11.50$, $p<.0001$. A subsequent post hoc analysis using the Student-Neuman-Keuls procedure showed a significant difference at the .05 level between the four- and five-year-olds and the

eight-year-olds and the adults. Neither the four- and five-year-olds nor the eight-year-olds and the adults significantly differed from one another.

Happy Cue Manipulation Task. The average accuracy scores on the Happy Cue Manipulation Task for the four-, five-, eight-year-olds and adults were 1.64, 2.04, 1.76, and 2.41, respectively. The accuracy scores of all four age groups were then compared to chance performance utilizing a one-tailed one-sample t-test with an α of .05, as depicted in Table 4. The five-year-olds and the adults performed significantly above chance on this measure; $t(24)=2.91$, $p=.0039$; and $t(23)=6.23$, $p<.0001$, respectively. The eight-year-olds just failed to exceed the chance level, $t(28)=1.68$, $p=.0524$, while the four-year-olds scores were at chance level, $t(24)=0.97$, $p=.1711$. To investigate differences in accuracy as a function of age, the total accuracy scores were entered into a one-way analysis of variance which found a main effect for age group, $F(3,96)=4.81$, $p=.0037$. A subsequent post hoc analysis using the Student-Neuman-Keuls procedure showed a significant difference at the .05 level between the four- and eight-year-olds and the adults. Neither the four-, five-, and eight-year-olds nor the five-year-olds and the adults significantly differed from one another.

Discussion

Evidence for the hypothesized early emergence of emotion decoding skills based on dance forms of expressive movement was identified in this study. The age at which children begin to recognize emotional meaning in salient expressive body movement was advanced developmentally from eight years of age (Custrini & Feldman, 1989; DePaulo & Rosenthal, 1979; Van Meel et al., 1993) to the four- to five-year age range. Four-year-olds demonstrated above-chance decoding of sad expressions. Five-year-old children were clearly discriminating the individual emotions of happiness, sadness, and fear. Further, the five-year-olds' failure to exceed chance with anger on the contrast task was accompanied by their better-than-chance use of the directional changes in face and torso cue to decode relative levels of anger intensity. The combined patterns of performance in the two tasks by the youngest children reflect the emergence of verbal decoding ability in the four to five year period. Ability then improves substantially between five and eight years of age, as reflected

by the general comparability between eight-year-olds and adults in the present study. These findings parallel those reported in emotion perception research with the other nonverbal channels. During the preschool years children begin to verbally identify discrete emotional meaning in these dance forms of expressive body movement as they do in facial expressions (Izard, 1971; Odom & Lemond, 1972; Reichenbach & Masters, 1983; Stifter & Fox, 1987; Walden & Field, 1982), voice/prosody (Berk et al., 1983; Hortaçsu & Ekinci, 1992; Stifter & Fox, 1987), and music (Cunningham & Sterling, 1988; Terwogt & Van Grinsven, 1988).

The present pattern of differences in the accuracy of decoding among the specific emotions extends previous evidence that the developmental order of emergent sensitivity to the basic emotions varies as a function of nonverbal channel. The current study found that sadness was the earliest emotion category to be recognized. In contrast, research on the emergence of emotion recognition in facial expression and music has shown that happiness is developmentally the first to be recognized (Cunningham & Sterling, 1988; Odom & Lemond, 1972; Reichenbach & Masters, 1983; Terwogt & Van Grinsven, 1988), while similar research in prosody suggests that anger might be the first emotion to be recognized developmentally (Hortaçsu & Ekinci, 1992; Stifter & Fox, 1987). This varied pattern of sensitivity is consistent with the conjecture offered by Hortaçsu and Ekinci (1992) that the specific differences among cues which convey emotional expression in the various nonverbal channels may result in such differential accuracy. Certain emotion-specifying spatiotemporal structures may be more effectively embedded in some nonverbal media than in others.

In the Walden and Field (1982) study, sensitivity to emotion-specific cues was demonstrated by analyzing the pattern of mistakes made by children in attempting to match verbal labels of emotion categories to facial expressions of these emotions. In the current study, cue utilization was measured by having subjects make judgments of emotion intensity as a function of systematic cue manipulation. Specifically, it was shown that children as young as five will utilize the cues previously associated with the adult attribution of anger

and happiness to make ratings of greater emotional intensity for segments which contain a greater number of those cues. Use of the anger cue emerged at an earlier age than hypothesized. However, it is also the case that the reliance on the cue of directional changes in face and torso increases with age and that it is interesting to note that the accurate identification of anger shows a concomitant leap with anger cue utilization between the ages of five and eight. Further research, with more specific and direct measures of perceptual and production skills, would help in determining how much of the process of emotion perception was based upon a more sophisticated perception of various spatiotemporal forms.

However, while the increased reliance on the directional changes in face and torso cue in decoding the intensity of anger appears to match the increased ability to identify displays of anger relative to other emotion categories, this was less clearly demonstrated with the frequency of upward arm movement cue associated with happiness. While there was an increase in reliance on the frequency of upward arm movement in decoding the intensity of happiness from four to five years of age, there was no difference between the four- and five-year-olds in the identification of happiness compared to other emotion categories, though it should be noted that five-year-old performance was significantly above chance while the four-year-old performance was not. Further, the apparent decrease in reliance on the frequency of upward arm movement cue in decoding the intensity of happiness among the eight-year-olds is also somewhat anomalous. These findings suggest that other structural cues contributing to the specification of happiness need to be identified and explored developmentally. One possibility is that in becoming attuned to one stimulus cue, sensitivity to other previously mastered cues may suffer. Within the current study, it has been shown that the refinement of cue attunement may not increase emotion recognition ability in all cases; while children with a less developed cue attunement pattern appear to be able to distinguish sadness, adults with a more developed cue attunement pattern appear to have a harder time. Given the findings from a discriminant analysis reported in Boone and Cunningham (1996) that sadness and fear are the least easy for adults to discriminate on the

basis of the given cues, it is possible that in trying to further refine their identification of fear, adults make more errors in distinguishing sadness from fear.

More research on the developmental sensitivity to stimulus cues and its impact on emotion decoding is needed. The current study is limited by the fact that only two cues were studied. A systematic investigation of other cues, such as leaning forward and muscle tension, and their developmental impact on the attribution of sadness and fear is clearly warranted. Future investigations should also consider the joint manipulation of a several cues. Additionally, while dance may be an effective medium for the initial identification and exploration of the relationship between movement cues and emotional meaning, future research including movement expressions characteristic of everyday interpersonal exchange would be required to establish the degree to which spatiotemporal invariants such as direction, force, timing, and velocity combine to yield information about the attribution of emotion.

While the current study documents developmental growth in the ability to decode emotional meaning in expressive body movement, more research is required to understand what aspects of development contribute to this increased ability. These findings are consistent with the hypothesized relationship between motoric ability and the utilization of specific structural cues in the identification of emotional expression. As previously argued, one possibility is that certain motoric skills may be necessary prior to the cue attunement to and perception of specific cues (Bushnell & Boudreau, 1993). If so, motoric skill would limit the number of cues a child may perceive in their decoding of emotion.

While necessary, however, such motoric experience may not be sufficient to generate the perception of emotional meaning. A longitudinal study including children from ages four to eight and focused on the degree to which a child's motoric performance is associated with cue utilization would help shed light on the relationship between production and perception in this domain. Dance affords an ideal developmental medium for the investigation of the relations among production, perception, and cue utilization once the child is more verbally skilled. Unlike the expression of facial and prosodic cues which

emerge prior to or simultaneous with low level verbal skills, and the expression of music cues which require years of intensive training to master, the expression of several of the more complex cues associated with dance forms of expressive body movement are acquired after the child has developed good verbal skills. This will allow for a closer examination for the correspondence between production and perception of the motoric cues which specify emotional meaning.

These overall findings provide support for the perception and the identification of cue utilization patterns in the developmental acquisition of emotion recognition. By using the methodology employed by this study, it should be possible to investigate production of actions based upon specific cues and how these cues are then utilized in the attribution of emotion. A variant of the current methodology could also be adapted to preferential looking and habituation paradigms to explore questions of categorical discrimination and structural specification of emotion at younger ages.

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Footnotes

[1]Seven dichotomous cues actually yields 128 combinations (2^7). However, not all combinations were physically possible to make, leaving a total of 96 viable combinations.

[2]Originally the Emotion Intensity Tasks contained an additional six segment pairs in which the emotion category of the manipulated cue did not match emotion category of the manipulated segment. All subjects were exposed to these six segment pairs, but given the failure of these items to demonstrate a reliable difference in emotional intensity, the data from these segment pairs was not considered in the current study.

[3]According to Howell (1992), the Bonferonni is used as an adjustment to counteract the effect of family-wise error for post-hoc tests. What level to use when making a specific comparison is usually left to the discretion of the experimenter, depending upon what was an a priori hypothesis and what was a post-hoc test. While comparing the overall accuracy score to chance for each group was a planned comparison ($\alpha = .05$), further comparisons within each group by emotion category warranted a more conservative approach. Therefore, within each age group, performance compared to chance for each emotion category was accomplished by utilizing a one-tailed one sample t-test with a Bonferonni α of .0125 (.05 divided by 4, the number of emotion categories investigated within each age group).

Table 1

Stimulus segments used in Emotion Contrast Task

Segment Pair Number	Sex	Performance on Left: Emotion Category	Performance on Left: Percent Interrater Agreement Level (N=40)	Performance on Right: Emotion Category	Performance on Right: Percent Interrater Agreement Level (N=40)
1	Male	Fear *	100	Sadness	97.5
2	Female	Happiness	100	Anger *	90.0
3	Male	Anger	95.0	Fear *	97.5
4	Female	Happiness *	100	Fear	100
5	Male	Anger	92.5	Sadness *	97.5
6	Male	Happiness	97.5	Fear *	82.5
7	Female	Sadness*	97.5	Happiness	100
8	Male	Happiness *	100	Anger	95.0
9	Female	Sadness	97.5	Anger *	100
10	Female	Fear	87.5	Sadness *	90.0
11	Male	Happiness *	97.5	Sadness	87.5
12	Female	Anger *	97.5	Fear	100

*Indicates which of the two performances was the Target Emotion for the Emotion Contrast Task

Table 2

Stimulus segments used in Emotion Intensity Task

Segment Pair Number	Sex	Dominant Emotion Category	Percent Interrater Agreement Level (N=40)	Side with Greater Level of Critical Cue
Angry Cue Manipulation Task			Cue Manipulated:	Frequency of Directional Changes in Face and Torso
1	Male	Anger	95.0	Right
2	Male	Anger	85.0	Right
3	Female	Anger	90.0	Left
Happy Cue Manipulation Task			Cue Manipulated:	Frequency of Upward Arm Movement
4	Female	Happiness	100	Left
5	Male	Happiness	100	Right
6	Female	Happiness	100	Left

Table 3

Mean Accuracy Scores on the Emotion Contrast Task as a Function of Emotion and Age Group

Accuracy Score	Mean	Standard Deviation	N	t-value	Probability
Four-year-olds					
Happiness	1.72[a]	0.89	23	1.07	0.1145
Sadness	1.96[a]	0.86	23	1.87	0.0113
Anger	1.84[a]	0.99	23	1.59	0.0489
Fear	1.80[a]	0.96	23	1.02	0.0651
Five-year-olds					
Happiness	1.92[a]	0.94	24	2.20	0.0107
Sadness	2.48[b]	0.66	24	7.13	0.0001
Anger	1.88[a]	0.93	24	1.78	0.0257
Fear	1.88[a]	0.73	24	2.48	0.0076
Eight-year-olds					
Happiness	2.66[c]	0.55	29	11.25	0.0001
Sadness	2.79[c]	0.41	29	16.90	0.0001
Anger	2.76[c]	0.51	29	13.27	0.0001
Fear	2.28[b]	0.70	29	5.95	0.0001
Adults					
Happiness	2.79[c]	0.42	24	15.25	0.0001
Sadness	2.50[b]	0.66	24	6.51	0.0001
Anger	2.96[c]	0.20	24	35.01	0.0001
Fear	2.50[b]	0.59	24	8.30	0.0001

Range of Scores: 0 to 3, Expected Chance Mean = 1.5

Note Different letter superscripts indicate scores that are significantly different from one another.

Table 4

Mean Accuracy Scores on the Emotion Intensity Task as a Function of Emotion and Age Group

Accuracy Score	Mean	Standard Deviation	N	t-value	Probability
Anger Cue Manipulation Task					
Four-year-olds	1.65[a]	0.83	25	0.60	0.2767
Five-year-olds	1.96[a]	0.81	25	2.85	0.0044
Eight-year-olds	2.59[b]	0.78	29	7.53	0.0001
Adults	2.63[b]	0.58	24	9.57	0.0001
Happy Cue Manipulation Task					
Four-year-olds	1.64[c]	0.72	25	0.97	0.1711
Five-year-olds	2.04[d]	0.93	25	3.06	0.0039
Eight-year-olds	1.76[c]	0.83	29	1.68	0.0524
Adults	2.42[d]	0.72	24	6.23	0.0001

Range of Scores: 0 to 3, Expected Chance Mean = 1.5

Note: Within each accuracy score, different letter superscripts indicate scores that are significantly different from one another.

Figure Captions

Figure 1. Accuracy of Emotion Identification as a Function of Age and Emotion Category.

Note: Means shown in italics indicate chance level performance.

Figure 1

TOP