In press: *Journal of Nonverbal Behavior*

Can children recognize bodily expressions of emotion?

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Abstract

Past research has demonstrated that children understand distinct emotion concepts and can accurately recognize facial expressions of distinct emotions by a young age, but few studies have assessed the age at which children develop the ability to recognize bodily expressions of distinct emotions. The current pre-registered research is the largest study to date (N = 552) examining the age at which children begin to recognize static bodily expressions of three negative emotions: anger, fear, and sadness. Our findings suggest that bodily expressions of sadness are recognized at rates consistently above chance by the age of 3-years, fear around the age of 4 to 5 years, and anger between the ages of 6 and 8 years. Recognition of all three expressions increased with age. The current research is the first to address this question using an entirely between-subjects design, allowing us to rule out the possibility that accurate recognition occurred as a result of a process of elimination or memory. Together, these findings suggest that children can reliably identify distinct negative emotions from bodily expressions, and this ability varies by age and the specific emotion being identified.

Can children recognize bodily expressions of emotion?

The ability to accurately recognize emotion expressions is critical for navigating the social world. It is therefore not surprising that children understand distinct emotion concepts and can accurately recognize facial expressions of distinct emotions, including happiness, sadness, anger, and fear, by about 3 years of age (Camras & Allison, 1985; Felleman, Barden, Carlson, Rosenberg, & Masters, 1983; Izard, 1971; Camras, Grow, & Ribordy, 1983; Harrigan, 1984; Tracy, Robins, & Lagattuta, 2005; Szekely, Tiemeier, Arends, Jaddoe, Hofman, & Verhulst, 2011; Widen & Russell, 2003; Bretherton & Beeghly, 1982; Smiley & Huttenlocher, 1989; Dunn, Bretherton, & Munn, 1987; Bloom, 1998). However, a growing body of research suggests that emotions are communicated not only via the face, but also through the body. In fact, bodily communication of emotion may be just as important – and in some cases even more important – than facial expressions. Signals sent by the body may provide adaptive benefits that the face cannot: bodily expressions enable interpersonal communication when the face is not visible, and, in contrast to subtle facial muscle movements, effectively communicate across large distances.

A handful of studies have found that several distinct emotions are reliably communicated from bodily expressions even when the face is not visible (Abramson, Marom, Petranker, & Aviezer, 2017; Atkinson, Dittrich, Gemmell, & Young, 2004; Coulson, 2004; Dael, Goudbeek, & Scherer, 2012; De Gelder & Van den Stock, 2011; Witkower, Hill, Koster, & Tracy, in prep; see Witkower & Tracy, 2019, for a review). In particular, adults can recognize and discriminate distinct bodily expressions of three negative emotions at high rates (i.e., greater than 90% agreement): anger, sadness, and fear (e.g., de Gelder & Van den Stock, 2011; Van den Stock, Righard, & de Gelder, 2007). Bodily expressions of these three emotions are reliably recognized, even without the face visible, by adults across cultures, including the U.S. (Aviezer, Trope, &

Todorov, 2012; Lopez, Reschke, Knothe, & Walle, 2017), the UK (Atkinson, Dittrich, Gemmell, & Young, 2004), the Netherlands (de Gelder & Van den Stock, 2011), China (Ma, Chen, Ran, Ma, Zhang, & Liu, 2017), Israel (Abramson, Marom, Petranker, & Aviezer, 2017), and Japan (Sogon & Matsutani, 1989). In recent research, these three bodily expressions were found to be accurately recognized by the Mayangna, a small-scale traditional society in Nicaragua with little-to-no exposure to North American culture (Witkower, Hill, Koster, & Tracy, under review). Given their cultural isolation, these individuals are unlikely to have learned these bodily emotion displays from cross-cultural transmission (e.g., films, television, magazines), suggesting that, much like facial expressions of a small set of emotions, distinct bodily expressions of these three emotions may be universal features of the human behavioral repertoire. If this is the case, it is also likely that these expressions are recognizable by young children.

In fact, early childhood recognition of emotion expressions is likely to be particularly important, as children must accurately detect and perceive others' emotions in order to learn from those around them and successfully navigate their social worlds. Given the importance of detecting others' emotion in the course of early-life development, children may demonstrate an early-emerging ability to identify emotion from multiple cues alongside facial expressions, such as bodily displays, which they can then use to guide their social judgments, learning, biases, and decision-making (e.g., Skinner, Meltzoff, & Olson, 2016; Birch, Akmal, & Frampton, 2010; Brosseau-Liard & Poulin-Dubois, 2014). The ability to recognize and understand emotion expressions, in turn, has been shown to have a positive impact on children's academic and social competence, along with their cognitive development (Garner & Waajid, 2008; Nowicki & Duke, 1992; Raver, Garner, & Smith-Donald, 2007; Trentacosta & Fine, 2010; Trentacosta & Izard,

2007; Parker, Mathis, & Kupersmidt, 2013). It is therefore important to determine the extent to which bodily expressions contribute to children's ability to recognize emotions in others.

Yet research on the developmental trajectory of children's recognition of bodily expressions of emotion is sparse. Although infants as young as 5 months old can discriminate bodily movements on the basis of valence (i.e., infants prefer videos of happy bodily movement to those of neutral or angry bodily movement; Zieber, Kangas, Hock, & Bhatt, 2014; Heck, Chroust, White, Jurban, & Bhatt, 2018), few studies have tested whether young children can recognize and discriminate among similarly valenced bodily expressions of distinct emotions. One such study found that 4-year-olds could reliably detect sadness from bodily movement during dance, but these children were unable to detect fear from similar stimuli until around the age of 5 years (Boone & Cunningham, 1998). In another study, nearly half of the 4-year-old children recruited were unable to accurately sort bodily expressions of fear and sadness into appropriate categories (Mondloch Horner, & Mian, 2013). These findings suggest that 4-year-old children may not be able to consistently recognize and differentiate between bodily expressions of fear and sadness until age 5. However, both these studies relied on somewhat small sample sizes (i.e., Ns= 25, 12, for 4-year-old children), limiting confidence in this conclusion.

The largest study to date that directly tested children's ability to recognize and discriminate among bodily expressions of distinct emotions asked children aged 3, 4, and 5 (n = 48 per age group) to label the emotion presented in each of several videos (Nelson & Russell, 2011). These videos featured dynamic displays of emotion in four different formats: (a) the body of the expresser was visible but the face obscured, (b) the face of the expresser was visible but the body obscured, (c) neither the face nor body was visible, but the expresser vocally conveyed the emotion with intonation, speaking the words "I felt this feeling before; it was just a few days

ago", or (d) the face, body, and vocal display were all visible. All bodily expressions were generated on the basis of previously validated displays (Aviezer, Hassin, Ryan, Grady, Susskind, & Anderson, 2008; Van den Stock, Righard, & de Gelder, 2007), and further validated by an adult sample (see Nelson & Russell, 2011), in which body-only expressions were recognized at rates greater than 70%. When viewing these body-only expressions, children as young as 3 years reliably recognized expressions of anger, sadness, and fear at high rates (i.e., all greater than 60%); recognition of sadness was highest. This study also found that recognition of bodily expressions was slightly lower than recognition of facial expressions, but was still notably high, particularly given that the researchers used a free-response format, known to generate lower recognition levels across modalities of expression (Russell, 1993). These results thus suggest that children can recognize and discriminate among these three negatively valenced bodily expressions of emotion by the age of 3 years.

However, this study has several limitations that preclude strong conclusions about children's recognition of bodily displays. First, like most of the studies addressing this issue, Nelson and Russell (2011) used a repeated-measures design, such that all children were asked to identify all expressions in multiple trials. More specifically, participants completed the task four times for each format (i.e., body-only, face-only, voice-only, multi-cue), for a total of 16 trials. With this kind of design, children may realize that the same emotions are presented in multiple modalities, and achieve high recognition through a process of elimination or memory, potentially leading to an over-estimation in their ability to discriminate these expressions (Nelson & Russell, 2016; Digirolamo & Russell, 2016; Russell, 1993). In fact, to our knowledge no study has yet assessed children's ability to recognize bodily expressions of emotion using a between-subjects

design, which has the benefit of reducing learning effects and learning strategies that can inflate recognition rates.

Second, Nelson and Russell (2011), along with the only other reasonably well-powered study on this topic (Boone & Cunningham, 1998), used dynamic rather than static displays. Although dynamic expressions of emotion provide enhanced ecological validity, they amalgamate behavior types (i.e., spatial form; leaning back, tilting the head, hands in fists) with behavior qualities (e.g., fast, slow, jerky, flowing). Static bodily expressions, in contrast, enable researchers to examine recognition from spatial form in the absence of dynamic movement. An ability to recognize emotions from static bodily expressions suggests that specific configurations of bodily behaviors, independent of the dynamic qualities that might accompany those behaviors, contribute importantly to recognition (see, e.g., Witkower & Tracy, 2018; Tracy & Robins, 2004; Ekman & Friesen, 1971; Ekman & Oster, 1979). This is not to say that that dynamic qualities are not important, or less important than static features, but rather that an ability to recognize static bodily expressions in the absence of dynamic movement pinpoints the specific postural configurations that are associated with particular emotions, and suggests that these configurations are sufficient to communicate emotion, even in the absence of observed movement. Studies are therefore needed to assess children's ability to recognize static bodily expressions of emotion using a between-subjects design, and ideally one that is high powered.

The current pre-registered research (https://osf.io/d79v4/) is the largest study to date (N = 552) to examine the age at which children begin to recognize static bodily expressions of three negative emotions: anger, fear, and sadness. We restricted our investigation to these three emotions only, to ensure that accurate recognition could not be attributed to discriminations made on the basis of valence alone. The current research is also the first study to address this

question using an entirely between-subjects design in which only a single trial was employed for each participant. By viewing and responding to only one expression, children were prevented from using a process of elimination or knowledge acquired from previous trials to formulate responses. In order to expedite data collection and reduce the total number of participants needed to complete a study with this kind of design, all stimuli featured the same female target who posed all expressions; this allowed us to eliminate potential target effects that would be difficult to detect with an entirely between-subjects approach. The current research therefore represents a strong test of children's ability to recognize bodily expressions of emotion, by ruling out the possibility that children make accurate selections based on learning from repeated trials, and that dynamic qualities of bodily behaviors – rather than the visible behaviors themselves –contribute to recognition.

Based on the prior research, we preregistered our hypothesis that children would reliably recognize and discriminate among bodily expressions of the three emotions by age 4 – roughly the same age at which they reliably recognize facial expressions of emotion (https://osf.io/d79v4/). However, we also explored the trajectory of bodily emotion expression recognition from the age of 2 to 8 years old. Consistent with past research (e.g., Nelson & Russell, 2011; Boone & Cunningham, 1998), our exploratory (i.e., not preregistered) hypothesis was that the ability to recognize all emotions would increase with age.

Method

Participants

Five-hundred, fifty-two children between the ages of 1 and 12 years old (median = 4.96 years, *SD* = 1.97; 43% girls, 57% boys; 51% White/European, 22% East Asian or Pacific Islander, 16% mixed ethnicity, 6% South Asian, 2% Hispanic/Latino, 3% other) were recruited from a local science center in a Canadian city, and tested in a soundproof room on-site. As

specified in our pre-registration (osf.io/d79v4), we recruited participants until at least 46 4-5 year olds (range = 4.00 to 5.99 years) and 46 6-8 year olds (range = 6.00 to 8.99 years) had completed each condition, to provide 80% power to detect a recognition rate of 45% with a two-tailed test, with the proportion threshold (i.e., chance) set at 25% and alpha = .05.

Prior to data collection, we were uncertain about the feasibility of recruiting nearly 300 children – especially 150 4-year-olds. We therefore broadened our recruitment efforts and primary analyses to focus on children ranging in age from 4–5 years old, and 6-8 years. Nonetheless, we planned to assess recognition for each age group separately, in an exploratory manner (https://osf.io/d79v4/). Children younger than 4 years old and older than 8 years old were included in the study to honor an agreement with the science center, and we planned to analyze these data for exploratory purposes, but we ultimately excluded data for children older than 8 years due to small sample sizes (n < 10 for each condition). Children who did not understand the instructions, experienced parental interference, or were unable to complete the study after beginning the procedure (e.g., asked to stop, showed distress, or unable or unwilling to answer questions verbally or by pointing) were excluded from analyses (n = 4).

Materials

One female target posing bodily expressions of anger, sadness, fear, and neutral was selected for inclusion as stimuli, from the Bodily Expressive Action Stimulus Test (BEAST; see Figure 1). The BEAST is comprised of whole-body expressions of anger, fear, sadness, neutral, and happiness, with the face of each actor blurred and bodies fully visible. All nonverbal expressions from the BEAST are posed by undergraduate students from the Netherlands (de Gelder & Van den Stock, 2011). We chose to focus on expressions of anger, fear, and sadness for several reasons. First, by exclusively examining negatively valenced emotions, we can ensure

that recognition accuracy is not attributable to an ability to discriminate on the basis of valence alone. Second, there is strong evidence for the existence of distinct bodily expressions of these three negative emotions, but little-to-no strong evidence for a bodily expression of happiness that is distinct from other positive emotions (see Witkower & Tracy, 2019; de Gelder & Van den Stock, 2011). Third, our between-subjects design required roughly 150 children per condition, so the pool of available participants required us to limit the total number of stimuli included.

In the original study validating the BEAST, bodily expressions of anger, fear, and sadness were accurately recognized by undergraduates at rates greater than 90% across all targets, and for the specific target used in the current study all expressions were recognized at rates greater than 95% (de Gelder & Van den Stock, 2011). We also further validated these stimuli by assessing recognition among adult American MTurk workers; recognition rates for all three expressions were above 93% (see Witkower, Hill, Koster, & Tracy, in prep).

Figure 1. Bodily expressions of anger (top left), sadness (top right), neutral (bottom left), and fear (bottom right) used in the current study. Photos retrieved from the Bodily Expression Action Stimulus Test (BEAST; de Gelder & Van den Stock, 2011).

Procedure

After parents provided demographic information about their children, participants were shown four nonverbal displays at a time on an iPad (sadness, anger, fear, neutral; see Figure 1), presented in a randomized order in a 2x2 array, and prompted to select an image that corresponded to a randomly determined prompt, in a completely between-subjects design (i.e., each participant completed only one trial in which they responded to only one prompt). Specifically, children were asked, “Can you show me who is…” followed by one of three

options: mad (to assess anger), scared (to assess fear), or sad (to assess sadness). These emotion labels were developed to be appropriate and understandable for very young children, and were based on similar labels used in past research (e.g., Harrigan, 1984).[1] Given our goal of developing an assessment method with response options that were simple enough for very young children to understand, we opted not to include an "I don't know" option; indeed, this is a common approach in research on young children, who might choose an 'I don't know' option due to lack of confidence.

Results

Overview of analytic strategy

To test whether children accurately recognize bodily expressions of each emotion, our pre-registered plan was to assess the proportion of participants in each pre-registered age group that accurately selected the bodily expression corresponding to each prompt. We conducted these analyses separately by emotion. For all binomial tests chance was set at 25%, given that children selected from four expressions. Following these pre-registered analyses, we planned to conduct exploratory analyses treating age as a continuous predictor and analyzing the trajectory of bodily emotion recognition throughout development.

Preregistered analyses

Results showed, first, that in response to the sadness prompt, recognition rates in both preregistered age groups— 4-5 year olds and 6-8 year olds – were significantly greater than chance (ps < .001). More specifically, 4- and 5-year-olds (n = 54) selected the sad expression 89% of the time (95%CI [77% to 96%], and 6- to 8-year-olds (n = 62) selected the sad

[1]In the original paper by Harrigan (1984), the authors used the phrase "Mad at someone" for the emotional term "angry". In the current work, we opted to use the term "Mad" instead, to broaden the scope of the emotion beyond an experience directed toward one specific other individual.

expression 92% of the time (95%CI [82% to 97%]). As an exploratory analysis, we also assessed recognition rates for children aged 3-years and younger (n = 55; M age = 40.36 months, SD = 6.53 months). These participants accurately recognized sadness 71% of the time (95% CI [57% to 82%], $p < .001$). When they did not choose sadness, these younger participants were approximately equally likely to choose any of the three alternatives; there was no tendency to systematically select any particular other emotion instead of sadness (see Figure 2 and Table 1 for selection rates and binomial tests for both pre-registered age groups; for all confusions made by children of each age, see Table 2; for unbiased hit rates, see Tables S1 and S2 in the SOM).

We next conducted the same analyses for recognition of the fear expression. Again, participants in both age groups recognized bodily expressions of fear at rates significantly greater than chance (ps < .001; see Figure 2 and Table 1 for selection rates and binomial tests for each pre-registered age group). More specifically, 4- and 5-year-olds (n = 73) selected the fear expression 48% of the time (95%CI [36% to 60%]), and 6- to 8-year-olds (n = 56) selected the fear expression 82% of the time (95%CI [70% to 91%]). In our exploratory analysis of children aged 3-years and younger (n = 53; M age = 39.57 months, SD = 5.77 months), recognition of fear was not significantly greater than chance (32%; 95%CI [20% to 46%], p = .27). These younger children, when not selecting fear, tended to select sadness instead (M = 36%; for all confusions made by children of each age, see Table 2; for unbiased hit rates, see Tables S1 and S2).

Finally, we conducted the same analyses for recognition of the anger expression. Results showed that in response to the anger prompt, older children aged 6- through 8-years-old, but not younger children aged 4- and 5-years old, recognized anger at rates significantly greater than chance (see Figure 2 and Table 1 for selection rates and binomial tests for each pre-registered

age group). More specifically, children aged 4-5 (n = 69) selected anger 28% of the time (95%CI [17% to 40%], p = .68), and 6- to 8-year-olds (n = 50) selected the anger expression 62% of the time (95%CI [47% to 75%], p < .001). In our exploratory analysis of children aged 3-years and younger (n = 56; M age = 39.92 months, SD = 5.77 months), recognition of anger was not significantly greater than chance (18%, 95%CI [09% to 30%], p = .28). When these younger children did not select anger, they tended to select sadness instead (M = 45%). Similarly, among the 4-5 year-olds who did not correctly select anger, the most frequently selected expression was also sadness (M = 59%; for all confusions made by children of each age, see Table 2; for unbiased hit rates, see Tables S1 and S2).

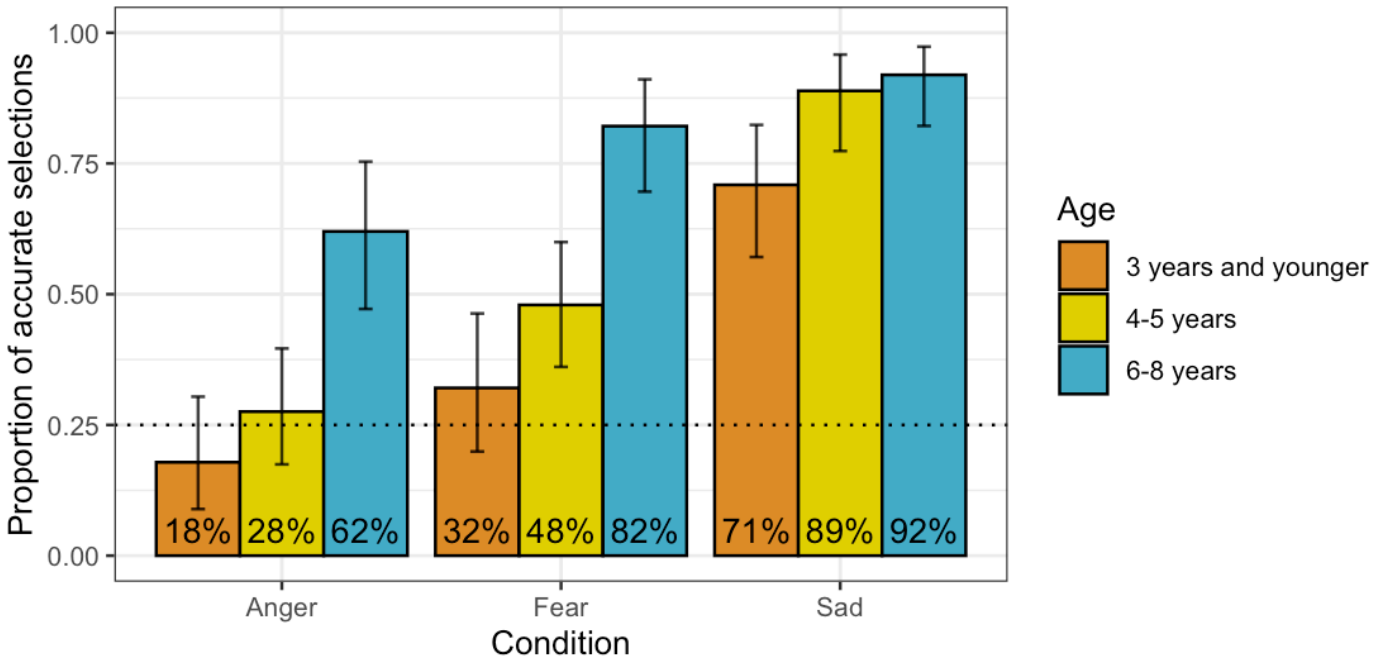

Figure 2. Children's accurate recognition rates for each bodily emotion expression, separated by pre-registered age group.
Note: Error bars indicate 95% CIs. The dotted line indicates chance guessing (25%).

Table 1. Selections made by participants in each pre-registered age group.

Prompt	Nonverbal display selected: Sad	Anger	Fear	Neutral	% of accurate selections	One-sample Binomial test (chance = 25%)
3 years and younger						
Sad	***39***	7	5	*4*	71%	$p < .001$
Anger	*25*	**10**	10	*11*	18%	$p = .28$
Fear	*19*	10	**17**	*7*	32%	$p = .27$
4-5 years old						
Sad	***48***	1	2	*3*	89%	$p < .001$
Anger	*41*	**19**	3	*6*	28%	$p = .68$
Fear	*19*	10	**35**	*9*	48%	$p < .001$
6-8 years old						
Sad	***57***	1	0	*4*	92%	$p < .001$
Anger	*14*	**31**	3	*2*	62%	$p < .001$
Fear	*4*	2	**46**	*4*	82%	$p < .001$

Note: Accurate selections in bold

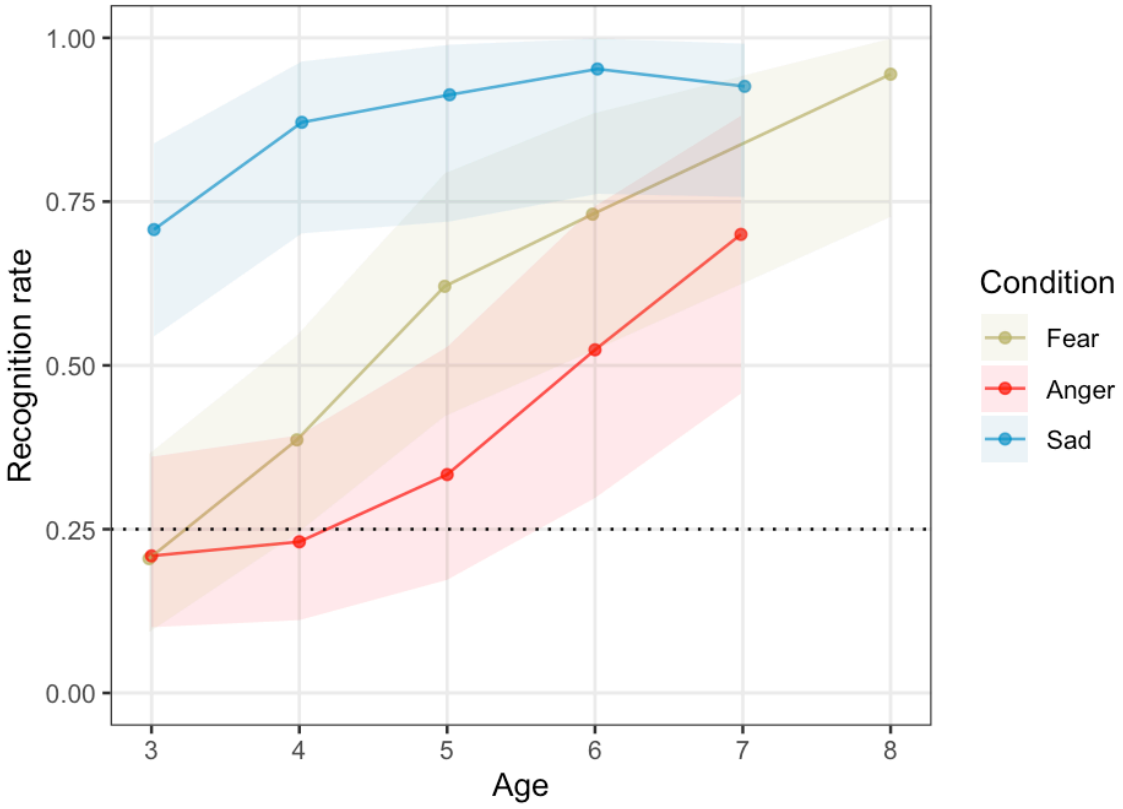

Figure 3. Recognition rates for participants in each emotion condition, by age. *Note:* Ribbons indicate 95% binomial CIs around proportions for each age within each condition. Only age groups that included at least 15 participants viewing each expression are visualized.

Table 2. Emotion expression selections, separated by participant age and condition

Age (years old)	*N*	Nonverbal display selected: Sad	Anger	Fear	Neutral	% of accurate selections	95% binomial CI
Sadness prompt							
2	*14*	**10**	3	1	0	71%	[42% to 92%]
3	*41*	**29**	4	4	4	71%	[54% to 84%]
4	*31*	**27**	1	0	3	87%	[70% to 96%]
5	*23*	**21**	0	2	0	91%	[72% to 99%]
6	*21*	**20**	0	0	1	95%	[76% to 99%]
7	*27*	**25**	0	0	2	93%	[76% to 99%]
8	*14*	**12**	1	0	1	86%	[57% to 98%]
Anger prompt							
2	*13*	6	**1**	2	4	8%	[00% to 36%]
3	*43*	19	**9**	8	7	21%	[10% to 36%]
4	*39*	22	**9**	3	5	23%	[11% to 39%]
5	*30*	19	**10**	0	1	33%	[17% to 53%]
6	*21*	8	**11**	2	0	52%	[30% to 74%]
7	*20*	4	**14**	1	1	70%	[46% to 88%]
8	*9*	2	**6**	0	1	67%	[30% to 93%]
Fear prompt							
2	*13*	1	2	**9**	1	69%	[39% to 91%]
3	*39*	17	8	**8**	6	21%	[09% to 36%]
4	*44*	13	8	**17**	6	39%	[24% to 55%]
5	*29*	6	2	**18**	3	62%	[42% to 79%]
6	*26*	3	2	**19**	2	73%	[52% to 88%]
7	*12*	0	0	**10**	2	83%	[52% to 98%]
8	*18*	1	0	**17**	0	94%	[73% to 99%]

Note: Correct responses are in bold. Participants younger than 2 years, and older than 8 years, were also recruited but their data are not presented here due to small sample sizes ($n < 9$).

Exploratory analyses

To explore change in recognition ability across development, we conducted a binomial logistic regression predicting recognition accuracy (1 = accurate selection; 0 = inaccurate selection) from age (continuous), condition (treated as a categorical variable, with sadness as the reference group), and the interaction between age and condition. No age by condition interactions emerged, bs $\leq$ .24, ps $\geq$ .12; in all three conditions, recognition accuracy improved with age; for sadness, b =.27, 95%CI [.05 to .52], p = .02, OR = 1.31, 95%CI: [1.05 to 1.68]; for anger, b =.51, 95%CI [.32 to .71], p < .001, OR = 1.66, 95%CI: [1.38 to 2.03]; and for fear: b =.44, 95%CI [.27 to .63], p < .001, OR = 1.55, 95%CI: [1.30 to 1.87].

General Discussion

The present research is the largest study to date to examine the age at which children can reliably recognize bodily expressions of three negative emotions: sadness, fear, and anger. Children aged 6-8 were able to recognize all three expressions at high rates that were significantly greater than chance. Four- and 5-year-olds were able to recognize sadness and fear expressions at rates significantly greater than chance, but this was not the case for anger. In addition, our exploratory sample of children aged 3-years and younger recognized sadness but not fear or anger. Additional exploratory analyses suggested that the sadness expression was recognized at rates consistently above chance as early as 2 years, fear by 5 years, and anger by 6 years. Recognition of all three expressions increased with age. Given that all emotion expressions examined were negatively valenced, accurate recognition cannot be attributed to an ability to discriminate on the basis of valence alone. Furthermore, the current study used a between-subjects design, allowing us to rule out the possibility of accurate recognition occurring as a result of a process of elimination or memory.

Together, these findings suggest that bodily expressions of sadness are recognized from an early age, whereas recognition of anger and fear from the body emerges later in development. Nelson and Russell (2011), who uncovered a similar pattern, suggested that these emotion differences might be due to children's sensitivity to the arousal of each expression. Sadness is the only low-arousal expression we studied, so young children's accuracy for this expression might be due to their ability to accurately discriminate between sadness and higher-arousal emotions like anger and fear; in contrast, their inability to recognize the latter expressions might be due to confusions between those two higher-arousal emotions. Arguing against this possibility, however, is our finding that children frequently confused high-arousal and low-arousal emotions with one another. In fact, for children ages 2, 3, 4, 5, and 6 years old, the most frequent incorrect selection in response to both the anger and fear prompts was the sadness expression (with the exception of 2-year-olds in response to the fear prompt; see Table 2). This pattern of results indicates that, rather than confusing high-arousal emotions, children's errors are likely due to their tendency to identify any negative emotion expression as sadness. This tendency is somewhat consistent with a similar pattern found in research on facial expression recognition; preschool children often overuse the label "sadness" to identify negative facial expressions. This overreliance on sadness words or expressions may result from children's more simplified emotion landscape, in which emotions are often broadly characterized as "happy" or "sad" (or "good" vs. "bad"; e.g., Widen & Russell, 2003). Importantly, if this interpretation is correct, and children somewhat indiscriminately use the sadness expression to characterize a broad array of negative emotion words, the high recognition rates observed for sadness here may not necessarily reflect a fine-tuned understanding of that expression, but rather an artifact of high

base rates of sadness selections. Indeed, when examining unbiased hit rates instead, children still accurately recognized sadness expressions, but at a much lower rate.

However, another possible explanation for the observed emotion differences is that, in the presence of young children, parents tend to down-regulate anger and fear emotional experiences, or conceal their expressions of these emotions, to avoid frightening kids. Selective emotion regulation along these lines could inadvertently delay the development of anger and fear recognition (e.g., Castro, Halberstadt, Lozada, & Craig, 2015; Denham, Bassett, & Zinsser, 2012). Future research is therefore needed to test whether parents' emotion regulation is related to their children's emotion expression recognition ability.

Another possibility is that evolutionary pressures facilitated an early-emerging ability to recognize sadness, and this ability is therefore present before the ability to recognize fear or anger. From a functionalist perspective, emotions can be considered specialized states that are shaped by natural selection to increase fitness in specific situations (Nesse, 1990). A primary function of sadness is to elicit help and caretaking from others (Hackenbrachy & Tamir, 2010), something young children are especially dependent upon. Although fear and anger also send important social messages, young children who cannot effectively signal sadness might fail to receive the care they need for basic survival. As a result, humans might have evolved to express, leverage, and consequently recognize in others, sadness, from a very young age. That said, it is also possible that humans have an early preparedness to experience and recognize whichever negative emotions they experience most, in their particular environments. The North American children examined here might have more experience early on with sadness, whereas children born into different cultural milieus might have more early experience with anger, and show a different pattern. Future studies are needed to probe all of these possible accounts.

It is important to note, however, that the present findings regarding sadness are somewhat inconsistent with prior findings that children reliably recognize bodily expressions of sadness, fear, and anger by 3-years of age (Nelson & Russell, 2011). However, the current research employed a much larger sample, and a between-subjects design, both of which could have contributed to the somewhat lower recognition rates observed here for younger children. Furthermore, Nelson and Russell (2011) used a priming procedure before experimental trials, in which they familiarized children with the research method and each emotion; the inclusion of this procedure is likely to have contributed to the higher recognition rates they observed. Finally, we used static images of bodily expressions rather than dynamic video clips. Given the possibility that recognizing emotions from dynamic videos and static images tap into different skill sets, future research on this topic should use and compare responses to both modalities (e.g., Atkinson, Dittrich, Gemmell, & Young, 2004). If the static nature of our stimuli is the reason that recognition rates observed here are lower than those found previously for dynamic stimuli, it would suggest that the dynamic qualities of bodily movements are important for the developing ability to recognize bodily expressions. Critically, past research suggests that the static presentation of facial expression stimuli does not decrease emotion recognition rates compared to dynamic facial displays, for children aged 3-5 years (Nelson & Russell, 2011b; Widen & Russell, 2015). Future research is therefore needed to test whether dynamism functions differently for bodily expressions compared to facial, and, if so, whether these movements are particularly important for the early development of this ability.

There are several limitations to the current research, which should be addressed in future work. First, while we expect the present effects to be robust to displayer demographics and morphology, given that adults reliably recognize bodily emotion expressions that are posed or

spontaneously displayed by targets varying in these ways (e.g., Abramson, Marom. Petranker, & Aviezer, 2017; De Gelder & Van den Stock, 2011), we recognize that only one female target was used in the current study. Future research is therefore needed to examine children's recognition of bodily expressions posed by additional targets, ideally varying in gender, ethnicity, height, and weight, to increase the generalizability of our findings, test for differences in recognition across these variables, and test for ingroup/outgroup differences. Second, we used static images of expressions rather than dynamic video clips, which would have allowed participants to observe expressions as they actually occur, with movement. Given the possibility that the recognition of expressions from dynamic videos and static images tap into different skill sets, future research is needed to address this issue by comparing the two modalities. However, the demonstrated ability to recognize static bodily expressions in the absence of dynamic movement still pinpoints the specific postural configurations that are associated with particular emotions, and suggests that these configurations are sufficient to communicate emotion. Third, the current research homes in on the ability to recognize emotion from bodily displays for children between the ages of 2-8 years, but future work should assess this ability across a wider age range. Prior studies have found that children's ability to recognize bodily expression of distinct negative emotions further improves—albeit more slowly—between ages 8 to 12, around the same age that children become more attuned to others perceptions of them (e.g., Ross, Polson, & Grosbras, 2012). Fourth, given our focus on a small set of negative emotions, future research should examine the development of children's ability to recognize a wider range of bodily expressions, including positive emotions, and should also include neutral expressions for purposes of control and comparison. Finally, children were not given the option to respond by saying, "I don't

know", a design choice that can artificially inflate accuracy (e.g., Russell, 1994; DiGirolamo & Russell, 2017); this, too, should be addressed with future replication studies.

In conclusion, the present research demonstrated that children can recognize bodily expressions of sadness by the age of 3-years, and bodily expressions of fear slightly later, around the age of 4 to 5 years. The ability to recognize bodily expressions of anger emerges still later, between the ages of 6 and 8 years. Recognition of all three bodily expressions improves across age.

Compliance with Ethical Standards

This study was funded by a Social Sciences and Humanities Research Council of Canada (SSHRC) Insight grant (grant number F17-04512). No authors have any conflicts of interest.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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