Social Behavior and Personality
an international journal

Social Behavior and Personality, Volume 49, Issue 9, e10329
https://doi.org/10.2224/sbp.10329
www.sbp-journal.com

Neural correlates of pride and joy recognition in early childhood

Yue Jiang[1]

[1]School of Teacher Education, Shangqiu Normal University, People's Republic of China

How to cite: Jiang, Y. (2021). Neural correlates of pride and joy recognition in early childhood. *Social Behavior and Personality: An international journal, 49*(9), e10329

I investigated neural processing during the recognition of pride and joy in early childhood using the event-related potential (ERP) technique. Electroencephalography recording was taken of 21 children aged between 4 and 6 years. They were shown photographs of familiar peers and strangers whose facial expressions displayed the emotion of either pride or joy. ERPs were recorded for the children's judgment of the expression of these two emotions when an image was presented. The results demonstrate that the neural dynamics during children's recognition of pride and joy involve three stages: The early negative component is spontaneously responsive to familiar faces, the mid-latency negative central component is responsive to expression of familiar faces, and the late positive component marks greater extended processing of an expression of pride. These findings provide new insight into the neural mechanism of pride and joy recognition in children aged 4 to 6 years.

Keywords
self-conscious emotions; emotion recognition; pride; joy; event-related potential; early childhood

Self-conscious emotions, of which the main ones are pride, embarrassment, guilt, and shame, play an essential role in individual social behavior (Sznycer, 2019). Empirical studies have shown that impairment of this emotion processing, such as less proneness to guilt or shame, or more proneness to hubristic pride, is associated with several neuropsychiatric disorders, such as social avoidance, depression, and autism spectrum disorder (Davidson et al., 2018; Heerey et al., 2003; Muris & Meesters, 2014). For example, children with autism spectrum disorder have been found to be less prone to guilt and more prone to hubristic pride, and to have lower emotion recognition than do neurotypical children (Davidson et al., 2018; Heerey et al., 2003). In light of this, examining the neural correlates associated with the processing of self-conscious emotions could be a clinically meaningful task for understanding the basis of these neuropsychiatric disorders.

Numerous researchers have explored the neural substrates of negative self-conscious emotions, such as embarrassment, guilt, and shame (see, for a review, Bastin et al., 2016). Studies have previously shown that these emotions might provide biomarkers to diagnose and prevent various negative self-conscious emotion-related neuropsychiatric disorders (Gilead et al., 2016; Green et al., 2013). In contrast to negative self-conscious emotions, the neural associations with the positive self-conscious emotion of pride have been relatively less investigated, particularly in childhood. Several empirical studies have reported that relational trauma (Benau, 2018), narcissistic personality disorder (Tracy et al., 2009), and affective disorder (Gray et al., 2011) might be associated with impaired processing of pride in children and adolescents. From the developmental perspective, exploring the neural dynamics of pride processing in early childhood might extend comprehension of the critical stage at which the neural underpinning of pride-related psychiatric disorders occurs.

CORRESPONDENCE Yue Jiang, School of Teacher Education, Shangqiu Normal University, 55 Pingyuan Road, Shangqiu 476000, People's Republic of China. Email: jiangyue2019@sqnu.edu.cn

Theoretical Background and Hypotheses

Function and Development of Pride

Compared with joy, *pride* refers to a more complex pleasant emotion resulting from achievements. The most direct distinction between pride and joy pertains to the self (Leary, 2007). When people pay attention to themselves, activate a self-representation, and ascribe the cause of positive or successful events to the "me" self, pride appears and motivates people to perform morally (Tracy & Robins, 2004). *Joy* does not involve self-related perception, which is driven by simple positive events.

Empirical studies have indicated that pride is essential for individuals' social functioning (Tracy et al., 2010; Williams & DeSteno, 2008). The expressing of pride plays a critical role in communication with others, enabling people to enhance their status, reminding observers of their successes, and implying that they deserve to be placed higher in the social hierarchy than do those others (Martens et al., 2012; Williams & DeSteno, 2009). Furthermore, recognition by the receiver of the expression of pride is crucial for communicating the emotional state and regulating social interaction (Shariff & Tracy, 2009). Theorists have found that children display pride responses when they succeed in a task before the age of 3 years (see, e.g., M. Lewis et al., 1992) and can distinguish pride experienced by adults, peers, and even themselves from other basic emotions, such as joy or surprise, from the age of 4 to 5 years. It has also been found that children's pride recognition ability increases in the period from 4 to 7 years old more than for other age groups (Garcia et al., 2015; Tracy et al., 2005). Thus, pride recognition is especially important for peer communication early in childhood (Nelson & Russell, 2012).

Previous Studies on Neural Correlates of Children's Emotion Processing

The event-related potential (ERP) technique is a noninvasive physiological measure featuring simplified stimuli and task parameters (Todd et al., 2008), and is regarded as more suitable compared with functional magnetic resonance imaging (fMRI) or positron emission tomography (PET) for the neuroscientific study of young children (e.g., Bennett et al., 2018). Although many child development studies have been conducted to explore the ERP components associated with children's basic emotions (e.g., Jusyte et al., 2017), to my knowledge, none have investigated pride recognition. In comparative studies scholars have outlined some of the ERP components sensitive to emotional understanding in early childhood (Bennett et al., 2018), including facial processing (Batty & Taylor, 2003, 2006) and the sociocognitive ability that allows individuals to understand the thoughts and feelings of others (theory of mind; Liu et al., 2004, 2009). These ERP components might be the cortical responses of children for pride recognition.

The N170 is an early negative ERP component recorded between 130 and 200 ms after a stimulus is presented. In adults the reading peaks at between 160 and 170 ms in the occipital-temporal area. Many studies have reported that usually (but not invariably), from early childhood, N170 marks the categorization and personal familiarity of faces. Taylor and colleagues (1999) found an adult-like morphology of the N170 component in young children for discriminating between faces or objects. Basing their conclusions on behavioral data, Mondloch et al. (2002) suggested that children aged 4 years could distinguish upright from inverted faces, just as adults can. Therefore, the specialized quality of N170 for face processing may occur by the age of 4 years (Todd et al., 2008). In addition, Parker and Nelson (2005) found the amplitude of N170 following presentation of caregivers' faces was smaller than the amplitude following presentation of strangers' faces. Todd et al. (2008) found a larger amplitude of N170 among children aged between 4 and 6 years when they were shown faces of mothers of other children than when they were shown personally familiar faces.

The Nc is a mid-latency negative ERP component that deflects between 225 and 700 ms in young children; the comparable component in adults may be N400 (Eimer, 2000). Several studies have concluded that the

Nc marks young children's facial familiarity and emotional expression valence: Carver et al. (2003) found that, compared to faces of strangers, infants responded to their mother's face with greater Nc amplitude, and that older children aged from 45 to 54 months had an opposite pattern, responding with greater Nc amplitude following presentation of strangers' faces, compared with the presentation of their mother's face. Likewise, Parker and Nelson (2005) observed greater Nc amplitude in young children following presentation of strangers' faces. In contrast, Todd et al. (2008) reported finding that by 4 years old, children were more sensitive to their mother's face than to a stranger's face, with a greater Nc amplitude that was similar to that for the N400 in adults. It has been suggested that the Nc may mark recognition memory (de Haan & Nelson, 1997). Furthermore, several studies have found that the Nc component was more responsive to negative facial expressions than to positive facial expressions in preschool-aged children (Batty & Taylor, 2006; M. D. Lewis et al., 2007; Todd et al., 2008). To date no studies have explored the difference in Nc amplitude in preschool-aged children's responses to pride and joy expressions. It is unknown if preschool-aged children are more sensitive to the more complex emotion of pride than they are to the emotion of joy, and if they are, by how much.

The LPC is a later frontal positive ERP component that generally emerges between 500 and 600 ms following presentation of a stimulus (Cunningham et al., 2005). Some studies have found that the LPC might mark the extended responses in children to more complex social cognitive processing, such as cognitive theory of mind (Liu et al., 2004, 2009), emotional understanding (Bennett et al., 2018), and cognitive reappraisal (DeCicco et al., 2012). On the basis of these findings, the LPC has been assumed to be associated with children's ability to infer the emotional valence and mental state of other social agents. For example, Bennett et al. (2018) used the ERP technique to examine children's responses to situations involving emotional understanding and found a more prominent LPC component following an unexpected task with emotional content.

Therefore, in early childhood, pride recognition might invoke a series of ERP components, such as N170, Nc, and LPC, from early spontaneous facial processing to later extended responses to pride expression. Münte et al. (1998) studied adults' emotion recognition and found that the individual's response to identification of a face was indicated by activation of the early ERP components, whereas the response to facial expression was indicated by activation of the later ERP components. Strauss and Moscovitch (1981) reported finding that facial emotional expression was processed more slowly than was facial identity. Facial identity or familiarity has been considered the constant factor of faces and, in real-life encounters, needs to be identified rapidly. However, facial emotional expression, which is constantly changing, needs to be tracked continuously (Calder & Young, 2005). Todd and colleagues (2008) initially found this fundamental motivational pattern in preschool children's responses to personal familiarity and basic emotional expression. Therefore, I was interested in whether such a temporal pattern would also be responsive to pride recognition in early childhood.

The Current Study

To examine children's dynamic cortical responses to pride recognition, I chose the emotional expression (pride vs. joy) of children's familiar peers and unfamiliar peers (strangers) as stimuli in the emotion recognition task. On the basis of past neural studies on children's processing of facial emotions, I generated the following hypotheses:

Hypothesis 1: The amplitude of the early negative component (N170) will be sensitive to young children's response to personal familiarity of faces, and the amplitude will be greater following presentation of faces of peers who are strangers.

Hypothesis 2: Response to emotional expressions of familiar faces will be indicated in young children by activation of the mid-latency component (Nc).

Hypothesis 3: The response of young children to a facial expression of pride will have a larger amplitude for the later frontal positive component (LPC) than will their response to an expression of joy.

Method

Participants

Participants were 33 right-handed children aged between 4 and 6 years old, without neuropsychiatric disorders, who were attending a kindergarten. In a pretest all the children could distinguish between expressions of pride and joy. Data obtained from eight participants were excluded from analysis because of excess movement artifacts generated by the children speaking frequently, moving their head, and/or blinking during the recording of the electroencephalograph, and a further four participants did not finish the experimental task. Thus, the final group of participants included 21 children (11 girls and 10 boys; M_{age} = 64.50 months, *SD* = 5.38, range = 66–78). All participants' parents signed an informed consent form and each child received a gift valued at approximately USD 15.00. This research was approved by the Shangqiu Normal University Research Ethics Committee.

Materials

I compiled two sets of four images (eight photographs in total), with each image capturing a child's upper body and face. One set was made up of photographs of a boy who was a stranger and a girl who was a stranger with a facial expression of either pride or joy, and the other set was made up of photographs of boy and girl peers who were familiar to the children taking part in the study and who had a facial expression of either pride or joy. The children in the photographs had an average age of 60.80 months.

The images of strangers expressing pride and joy had been used by Yang et al. (2012). There were 32 facial expressions showing pride selected for each young actor. To establish which images best depicted the focal facial expression, 352 preschool teachers and 156 mothers participated in a recognition task. I discovered that children's prototypical pride expression physically combined a smile, head tilted slightly back, expanded posture, and arms akimbo. The recognition rate for the images was above 70%.

I photographed familiar peers of the children expressing pride and joy against the light and in quiet conditions according to the prototypical expression of pride and joy. The prototypical expression of joy was determined as the child having eyes narrowed, cheeks lifted, mouth pulled back, lips slightly parted, and arms hanging straight down at each side of the body. The male and female actors who were photographed for the images had been in the same class as the participants for over 1 year. There were 20 photos taken of each child within 30 minutes. Mothers took part in a recognition task, and 58 of them recognized the images for emotion type and intensity. I selected the four images of peers' pride and peers' joy that were rated as having the highest intensity level on a 5-point Likert scale ranging from 1 to 5 (boy pride: *M* = 4.6, *SD* = 1.2; girl pride: *M* = 4.5, *SD* = 1.3; boy joy: *M* = 4.8, *SD* = 1.1; girl joy: *M* = 4.6, *SD* = 1.3). I removed from the images any accessories the children had in their hair, and any logos or stains on their clothing. The standard sets of 2.5 × 3 inch color images were controlled to all have the same contrast and luminance levels.

Task

E-Prime software was used to present the stimuli. The experimenter read out to the children the instructions showing on the screen, using a clear and kind tone of voice. After 16 practice trials, there were 192 main trials, divided into three blocks of 64 trials each. Children had a short pause of approximately 3 to 5 minutes between each block.

Each trial began with a fixation cross lasting 1,000 ms located at the neck position of the upper bodies in the images, that is, moderately higher than the center of the screen. Next, the emotional stimulus was presented for 600 ms. Next, a blank screen was presented for 1,500 ms and subsequent trials followed the same pattern (see Figure 1).

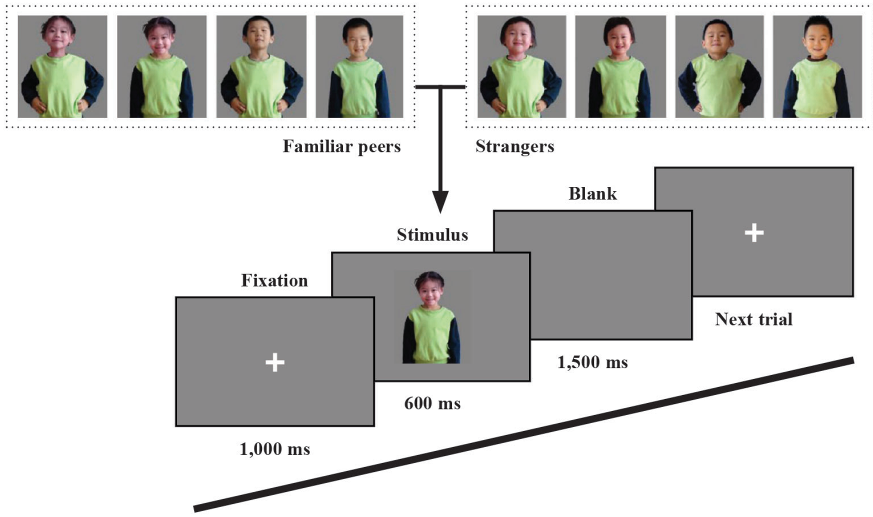

Figure 1. *Task Design and Sequence of Trials*

There were four types of emotional stimuli: peer pride, peer joy, stranger pride, and stranger joy, with 48 trials for each type. The stimuli were randomly shown in each block.

Procedure

The experiment was implemented in a sound-attenuating and shielded laboratory. After becoming familiar with the laboratory conditions, participants were asked to sit in a comfortable chair, placed at 60 cm distance from a computer screen. Before beginning the formal experiment, the participant completed a task distinguishing expressions of pride and joy in the images, and named the children in the images of familiar peers. For each participant, an experimenter who was familiar to the participant brought that child to the testing room.

Each child was given the following instructions: “Now, let us play a game; you need to keep your eyes on the fixation cross. If you see a joyful child, you are required to press the ‘1’ button, and if you see a proud child, press the ‘4’ button. Let us see who can do it quickly and correctly.”

The two buttons were counterbalanced across the participants. For self-assurance, the children were allowed to practice. To ensure the children were comfortable, for example, not afraid of being alone, and not needing to go to the toilet, one experimenter accompanied the children during the testing procedure, gently instructing them about paying attention to the task and staying still and quiet, moving as little as possible and not talking. It took about 10 minutes for each child to complete the 192 trials, and around 15 to 20 minutes for the whole test, including the 3- to 5-minute break between each block of trials.

Data Analysis

Behavioral data (accuracy rate and reaction time) were recorded by E-Prime version 2.0 software. EEGs were acquired continuously using a children’s unique electrode cap with 64 channels and EGI software (EGI, Oregon, USA). All electrode recordings took Cz (channel 65) as a reference. During the recording, the impedances of the electrode were conducted under 50 KΩ. The EEG signals were amplified online, digitally filtered with a 1–30 Hz bandpass, and sampled at 250 Hz. I segmented the EEG data into epochs of 1.2

seconds, between 200 ms before and 1,000 ms after stimulus onset, and transformed the data to correct for baseline.

Based on previous studies (Taylor et al., 2004; Todd et al., 2008), I selected the electrode sites, where activation was maximal in the grand-averaged data for analyzing each component. In addition to the LPC, I measured the component's peak amplitudes at the largest peak waveforms in each condition for all the participants.

Three components, N170, Nc, and LPC, were analyzed. The N170 was measured between 180–280 ms at P7 and P8 (Meeren et al., 2005; Todd et al., 2008). The Nc was measured following the frontal P2 between 280–480 ms at Cz (M. D. Lewis et al., 2007; Parker & Nelson, 2005; Todd et al., 2008). The frontal LPC was measured from 600–850 ms at F3, Fz, and F4 (Bennett et al., 2018; Liu et al., 2009). The behavioral data were analyzed by repeated measure analysis of variance (ANOVA), with personal familiarity (peers vs. strangers) and emotional expression (pride vs. joy) as within-subjects factors. Analyses of all the amplitudes of all ERP components were performed separately by repeated-measures ANOVAs, with personal familiarity (peers vs. strangers), emotional expression (pride vs. joy), and all electrode sites except Nc (N170: P7 and P8; LPC: F3, Fz, and F4) as the factors.

Results

Behavioral Results

Descriptive statistics for accuracy and reaction time are displayed in Table 1. The accuracy of emotion recognition manifested no significant effects of personal familiarity, $F(1, 20) = 0.214$, $p = .648$, $\eta^2_p = .011$, or emotional expression, $F(1, 20) = 2.783$, $p = .111$, $\eta^2_p = .122$, nor was there any significant interaction between personal familiarity and emotional expression, $F(1, 20) = 0.682$, $p = .419$, $\eta^2_p = .03$.

The reaction times for emotion recognition demonstrated a significant main effect of personal familiarity, $F(1, 20) = 20.069$, $p < .001$, $\eta^2_p = .592$. Participants took more time to recognize strangers' expressions than those of familiar peers, which implied a faster distinction of peers' faces. However, there was no main effect of emotional expression, $F(1, 20) = 0.234$, $p = .634$, $\eta^2_p = .012$, and no interaction between personal familiarity and emotional expression, $F(1, 20) = 0.007$, $p = .933$, $\eta^2_p < .001$.

Table 1. *Behavioral Results According to Condition*

	Accuracy %				Reaction time (ms)			
	M	(*SD*)	*F*	*p*	*M*	(*SD*)	*F*	*p*
Familiar peers	83.3	(9.52)	0.214	.648	1158.9	(270.51)	29.069	< .001
Strangers	82.7	(11.77)	2.783	.111	1125.3	(305.31)	0.234	.634
Emotional expression								
Pride	84.1	(10.04)			1094.6	(283.95)		
Joy	81.9	(11.23)			1089.7	(296.65)		
Interactions			0.682	.419			0.007	.933
Peer pride	84.8	(8.56)			1061.0	(253.38)		
Peer joy	81.8	(10.37)			1056.9	(292.92)		
Stranger pride	83.3	(11.50)			1128.1	(314.20)		
Stranger joy	82.1	(12.29)			1122.5	(303.89)		

Note. $N = 21$.

Event-Related Potential Results

N170

Figure 2 displays ERP waveforms for the children's pride and joy recognition processes at P7, Cz, and Fz electrodes. In the occipital–temporal region, there was a significant main effect of N170 amplitude for recognition of the emotions on the faces of familiar peers, $F(1, 20) = 6.83$, $p < .05$, $\eta^2_p = .255$, with larger amplitudes for recognition of the emotions on strangers' faces (−3.84 ± 1.98 μV) than on peers' faces (−3.54 ± 1.76 μV). No main effect of emotion expression was found, $F(1, 20) = 1.00$, $p = .328$, $\eta^2_p = .048$, sites, $F(1, 20) = 0.68$, $p = .420$, $\eta^2_p = .033$, nor was any interaction found between or among the three variables (*p*s > .05).

Nc

As displayed in Figure 2, in the frontocentral region, a significant main effect of Nc amplitude was observed for familiar peers, $F(1, 20) = 14.48$, $p < .01$, $\eta^2_p = .420$, with larger amplitudes for recognition of emotions on peers' faces (−1.06 ± 0.82 μV) than on strangers' faces (−0.76 ± 0.64 μV), but no main effect of emotional expression, $F(1, 20) = 0.01$, $p = .931$, $\eta^2_p = .000$. Notably, a significant interaction was detected between familiar peers and emotional expression, $F(1, 20) = 4.92$, $p < .05$, $\eta^2_p = .197$, with the largest amplitudes for familiar peer pride (−1.20 ± 0.64 μV), a moderate amplitude for familiar peer joy (0.91 ± 0.96 μV), and the smallest amplitude for stranger pride (−0.62 ± 0.67 μV). In other words, the Nc amplitude activation was most significant when children were exposed to peers' pride, moderate when they were exposed to peers' joy, and least significant when they were exposed to strangers' pride.

LPC

Figure 2 shows the LPC waveform for pride and joy expression at the site of Fz electrodes. In the later frontal area, a significant main effect of LPC amplitude was observed for emotion expression, $F(1, 20) = 5.37$, $p < .05$, $\eta^2_p = .212$, with larger amplitudes for expression of pride (1.46 ± 1.11 μV) than for expression of joy (0.90 ± 1.50 μV). No main effect of familiar peers was found, $F(1, 20) = 0.08$, $p = .783$, $\eta^2_p = .004$, site, $F(1, 20) = 0.92$, $p = .415$, $\eta^2_p = .088$, nor any interaction between or among the three variables (*p*s > .05).

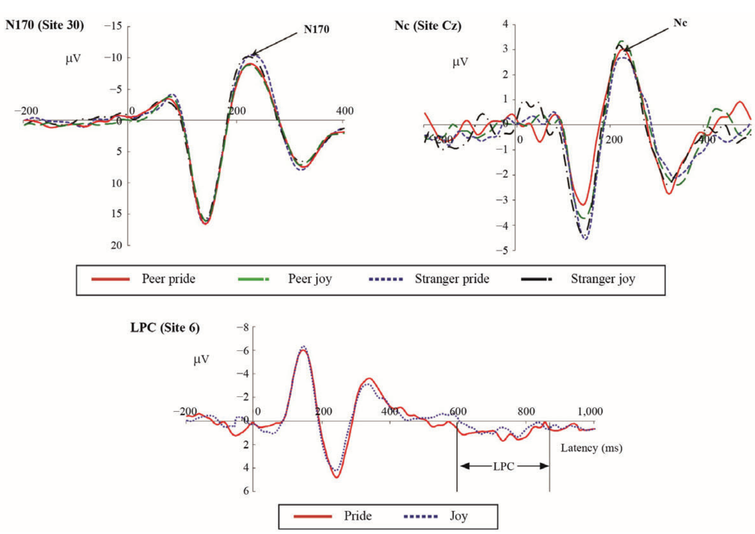

Figure 2. *Grand Averaged Waveforms at P7, Cz, and Fz for all Conditions for N170, Nc, and LPC*

Discussion

In this study I explored young children's neural processing to recognize facial expressions of the emotions of pride and joy of peers of different status (familiar, stranger). The results indicate that the N170 amplitude showed sensitivity to familiarity, with smaller amplitudes following presentation of peers' faces than presentation of strangers' faces. Although some researchers (e.g., Bentin & Deouell, 2000) have observed that adults do not distinguish famous from unfamiliar faces at N170, my findings provide new evidence for the view that in early childhood the N170 marks the early processing of personally familiar faces (Caharel et al., 2002; Herzmann et al., 2004). In accord with the results reported by Parker and Nelson (2005), who recorded smaller amplitudes of N170 following presentation of caregivers' than of strangers' faces, my results for the N170 suggest that even 4-year-old children can discriminate in judgment of important personality status. My behavioral results and the results of a previous behavioral study with adults (Gallegos & Tranel, 2005) show faster distinction of personally familiar faces than of strangers. These findings demonstrate that personal familiarity might expedite the neural course time of children's processing of facial expressions.

The amplitude for Nc was lower for familiar peers' faces than for strangers, consistent with past findings in studies with children (Todd et al., 2008) and the results for N400 in research conducted with adults (Bentin & Deouell, 2000). Prominently, I observed a significant interaction between personal familiarity and emotional expression, with the largest amplitude for familiar peers expressing pride, moderate amplitude for familiar peers expressing joy, and the smallest amplitudes for strangers expressing joy and pride. Thus, the Nc amplitudes that were larger show that children's increased sensitivity to expression of pride or joy at this site relied on personal familiarity with the person whose face was presented in the image. de Haan and Nelson (1997) stated that the Nc marks the salient emotional stimulus and recognition memory for more extensive processing. Children may retain the emotional appraisal and recognition memory from previous experience (Katzir et al., 2015). They frequently encounter the expression of joy on the faces and through the pose of the upper bodies of their peers throughout socialization, and the images I displayed to depict their peers' pride and joy would be familiar to them. Therefore, familiar peers' expressions of pride or joy would evoke more profound recognition memory than the images showing pride or joy of strangers, and an expression of pride, which may be associated with comprehensive appraisal, might elicit greater attention than would an image of expressing joy. My findings were the opposite pattern to those of Carver et al. (2003) and Parker and Nelson (2005), who recorded larger Nc amplitudes following the presentation of strangers' (vs. familiar) faces to participants at the stage of early childhood. Although, when no emotion is displayed, strangers' faces may be more salient to 4- to 6-year-old children than are peers' faces, the presentation of a familiar peer with a facial expression of pride may result in that face being more salient than a stranger's face.

For the LPC in the frontal area, response to the faces with an expression of pride was recorded as more significant between 600 and 850 ms. ERP studies have reported that in children the LPC might mark their extended responses to more complex social cognitive processing, such as theory of mind (Liu et al., 2004, 2009). As an adaptive social emotion, the processing of pride recognition is related to theory of mind (Shimoni et al., 2016). My results suggest that recognition of an expression of pride may elicit a more extended response than does recognition of an expression of joy, as with other social cognitions. Moreover, my result is consistent with an fMRI study that found adults' judgment of pride conditions activated the prefrontal regions of the brain related to the neural substrate of social cognition, but judgment of the primary positive emotion of joy did not (Takahashi et al., 2008). Thus, on the basis of my findings, I propose that in early childhood the LPC reflects the recognition of expression of pride, which is not influenced by personal familiarity to the viewer of the image presented.

In summary, my results suggest that in early childhood, the amplitude of the early N170 component is sensitive to personal familiarity; the mid-latency Nc amplitude is more sensitive to expressions on familiar faces than to expressions on strangers faces; and the LPC amplitude reflects the recognition of expression of pride, but is not influenced by personal familiarity. This paradigm of results suggests the neural time course to recognize pride in children in the 4- to 6-year age group. The neural pattern of these children's recognition of an expression of pride may involve three ERP stages: The amplitude of the early ERP component shows spontaneous sensitivity to personally familiar faces; the mid-latency ERP component amplitude shows sensitivity to particular expressions on familiar faces, which are more salient than are strangers' faces; and the late ERP component amplitude suggests extended recognition processing of the expression of pride.

This ERP pattern is consistent with the following previous findings: Münte and colleagues (1998) found that adults' behavioral responses are sensitive to face identity at the stage of earlier ERP components, and that adults respond to expression judgments at later stage ERP components. Todd and colleagues (2008) found that in early childhood more rapid processes are sensitive to personal familiarity, and sustained processes may index the emotional valence. A study in which electrodes were implanted in monkeys found a similar pattern of a transient and early response to facial familiarity, along with a more continued response in the neurons to facial expression (Sugase et al., 1999). In my study sensitivity in responses to facial familiarity were not recorded after 480 ms, whereas later ERP components extended to be sensitive to the expressions of the faces until 850 ms. A possible explanation is that if an individual has registered constant signals, such as familiarity or identity, there is no necessity to pay more attention to faces with neutral expressions (Todd et al., 2008). However, as people's expressions of emotion are the most critical social knowledge, observing such expressions may require continuous attentional monitoring by the individual who is observing the emotion (Calder & Young, 2005).

During children's socialization, they perceive and interpret emotional signals and behave according to emotional rules. In my study I devised a simplified version of young children's daily emotional communication in a laboratory context, proposing a temporal pattern for recognition of facial familiarity and of an expression of pride at the stage of development when children's self-conscious emotional knowledge abilities are just beginning to occur and develop.

In conclusion, this research is the first in which the neural time course of pride recognition in young children has been investigated by analyzing the amplitude of ERP components associated with personal familiarity and emotional expressions. Nevertheless, the research conclusions require further replication. From the emotional valence perspective, both pride and joy are positive emotions; it remains to be studied whether pride recognition has neural differences with neutral emotion, with basic negative emotions (e.g., anger), or with negative self-conscious emotions (e.g., embarrassment). From the perspective of emotional expression, images of both the upper body and face of children expressing either pride or joy were presented in this study's ERP experiment. Whether a response would occur that would generate recording of a significant amplitude for other ERP components when presenting facial cues or body cues separately remains to be determined.

Acknowledgments

This work was supported by the Doctoral Research Start-Up Funds of Shangqiu Normal University (700150), the Humanities and Social Science Project of Higher Education Institutions in Henan Province (2021-ZZJH-284), and the Young Core Teachers' Training Program of Shangqiu Normal University (2021GGJS06).

References

Bastin, C., Harrison, B. J., Davey, C. G., Moll, J., & Whittle, S. (2016). Feelings of shame, embarrassment and guilt and their neural correlates: A systematic review. *Neuroscience & Biobehavioral Reviews, 71,* 455–471.
https://doi.org/10.1016/j.neubiorev.2016.09.019

Batty, M., & Taylor, M. J. (2003). Early processing of the six basic facial emotional expressions. *Cognitive Brain Research, 17*(3), 613–620.
https://doi.org/10.1016/S0926-6410(03)00174-5

Batty, M., & Taylor, M. J. (2006). The development of emotional face processing during childhood. *Developmental Science, 9*(2), 207–220.
https://doi.org/10.1111/j.1467-7687.2006.00480.x

Benau, K. (2018). Pride in the psychotherapy of relational trauma: Conceptualization and treatment considerations. *European Journal of Trauma & Dissociation, 2*(3), 131–146.
https://doi.org/10.1016/j.ejtd.2018.03.002

Bennett, S., Larkin, H., Pincham, H., Carman, S., & Fearon, P. (2018). Neural correlates of children's emotion understanding. *Developmental Neuropsychology, 43*(4), 329–344.
https://doi.org/10.1080/87565641.2018.1432055

Bentin, S., & Deouell, L. Y. (2000). Structural encoding and identification in face processing: ERP evidence for separate mechanisms. *Cognitive Neuropsychology, 17*(1–3), 35–55.
https://doi.org/10.1080/026432900380472

Caharel, S., Poiroux, S., Bernard, C., Thibaut, F., Lalonde, R., & Rebai, M. (2002). ERPs associated with familiarity and degree of familiarity during face recognition. *International Journal of Neuroscience, 112*(12), 1499–1512.
https://doi.org/10.1080/00207450290158368

Calder, A. J., & Young, A. W. (2005). Understanding the recognition of facial identity and facial expression. *Nature Reviews Neuroscience, 6*(8), 641–651.
https://doi.org/10.1038/nrn1724

Carver, L. J., Dawson, G., Panagiotides, H., Meltzoff, A. N., McPartland, J., Gray, J., & Munson, J. (2003). Age-related differences in neural correlates of face recognition during the toddler and preschool years. *Developmental Psychobiology, 42*(2), 148–159.
https://doi.org/10.1002/dev.10078

Cunningham, W. A., Espinet, S. D., DeYoung, C. G., & Zelazo, P. D. (2005). Attitudes to the right- and left: Frontal ERP asymmetries associated with stimulus valence and processing goals. *NeuroImage, 28*(4), 827–834.
https://doi.org/10.1016/j.neuroimage.2005.04.044

Davidson, D., Hilvert, E., Misiunaite, I., & Giordano, M. (2018). Proneness to guilt, shame, and pride in children with autism spectrum disorders and neurotypical children. *Autism Research, 11*(6), 883–892.
https://doi.org/10.1002/aur.1937

DeCicco, J. M., Solomon, B., & Dennis, T. A. (2012). Neural correlates of cognitive reappraisal in children: An ERP study. *Developmental Cognitive Neuroscience, 2*(1), 70–80.
https://doi.org/10.1016/j.dcn.2011.05.009

de Haan, M., & Nelson, C. A. (1997). Recognition of the mother's face by six-month-old infants: A neurobehavioral study. *Child Development, 68*(2), 187–210.
https://doi.org/10.1111/j.1467-8624.1997.tb01935.x

Eimer, M. (2000). Event-related brain potentials distinguish processing stages involved in face perception and recognition. *Clinical Neurophysiology, 111*(4), 694–705.
https://doi.org/10.1016/S1388-2457(99)00285-0

Gallegos, D. R., & Tranel, D. (2005). Positive facial affect facilitates the identification of famous faces. *Brain and Language, 93*(3), 338–348.
https://doi.org/10.1016/j.bandl.2004.11.001

Garcia, D. J., Janis, R., & Flom, R. (2015). Children's recognition of pride. *Journal of Experimental Child Psychology, 137,* 85–98.
https://doi.org/10.1016/j.jecp.2015.03.010

Gilead, M., Katzir, M., Eyal, T., & Liberman, N. (2016). Neural correlates of processing "self-conscious" vs. "basic" emotions. *Neuropsychologia, 81,* 207–218.
https://doi.org/10.1016/j.neuropsychologia.2015.12.009

Gray, C. M. K., Carter, R., & Silverman, W. K. (2011). Anxiety symptoms in African American children: Relations with ethnic pride, anxiety sensitivity, and parenting. *Journal of Child and Family Studies, 20*(2), 205–213.
https://doi.org/10.1007/s10826-010-9422-3

Green, S., Lambon Ralph, M. A., Moll, J., Zakrzewski, J., William Deakin, J. F., Grafman, J., & Zahn, R. (2013). The neural basis of conceptual–emotional integration and its role in major depressive disorder. *Social Neuroscience, 8*(5), 417–433.
https://doi.org/10.1080/17470919.2013.810171

Heerey, E. A., Keltner, D., & Capps, L. M. (2003). Making sense of self-conscious emotion: Linking theory of mind and emotion in children with autism. *Emotion, 3*(4), 394–400.
https://doi.org/10.1037/1528-3542.3.4.394

Herzmann, G., Schweinberger, S. R., Sommer, W., & Jentzsch, I. (2004). What's special about personally familiar faces? A multimodal approach. *Psychophysiology, 41*(5), 688–701.
https://doi.org/10.1111/j.1469-8986.2004.00196.x

Jusyte, A., Gulewitsch, M. D., & Schönenberg, M. (2017). Recognition of peer emotions in children with ADHD: Evidence from an animated facial expressions task. *Psychiatry Research, 258,* 351–357.
https://doi.org/10.1016/j.psychres.2017.08.066

Katzir, M., Ori, B., Eyal, T., & Meiran, N. (2015). Go with the flow: How the consideration of joy versus pride influences automaticity. *Acta Psychologica, 155,* 57–66.
https://doi.org/10.1016/j.actpsy.2014.12.003

Leary, M. R. (2007). Motivational and emotional aspects of the self. *Annual Review of Psychology, 58,* 317–344.
https://doi.org/10.1146/annurev.psych.58.110405.085658

Lewis, M., Alessandri, S. M., & Sullivan, M. W. (1992). Differences in shame and pride as a function of children's gender and task difficulty. *Child Development, 63*(3), 630–638.
https://doi.org/10.1111/j.1467-8624.1992.tb01651.x

Lewis, M. D., Todd, R. M., & Honsberger, M. J. M. (2007). Event-related potential measures of emotion regulation in early childhood. *NeuroReport, 18*(1), 61–65.
https://doi.org/10.1097/WNR.0b013e328010a216

Liu, D., Sabbagh, M. A., Gehring, W. J., & Wellman, H. M. (2004). Decoupling beliefs from reality in the brain: An ERP study of theory of mind. *NeuroReport, 15*(6), 991–995.
https://doi.org/10.1097/00001756-200404290-00012

Liu, D., Sabbagh, M. A., Gehring, W. J., & Wellman, H. M. (2009). Neural correlates of children's theory of mind development. *Child Development, 80*(2), 318–326.
https://doi.org/10.1111/j.1467-8624.2009.01262.x

Martens, J. P., Tracy, J. L., & Shariff, A. F. (2012). Status signals: Adaptive benefits of displaying and observing the nonverbal expressions of pride and shame. *Cognition & Emotion, 26*(3), 390–406.
https://doi.org/10.1080/02699931.2011.645281

Meeren, H. K. M., van Heijnsbergen, C. C. R. J., & de Gelder, B. (2005). Rapid perceptual integration of facial expression and emotional body language. *Proceedings of the National Academy of Sciences of the United States of America, 102*(45), 16518–16523.
https://doi.org/10.1073/pnas.0507650102

Mondloch, C. J., Le Grand, R., & Maurer, D. (2002). Configural face processing develops more slowly than featural face processing. *Perception, 31*(5), 553–566.
https://doi.org/10.1068/p3339

Münte, T. F., Brack, M., Grootheer, O., Wieringa, B. M., Matzke, M., & Johannes, S. (1998). Brain potentials reveal the timing of face identity and expression judgments. *Neuroscience Research, 30*(1), 25–34.
https://doi.org/10.1016/S0168-0102(97)00118-1

Muris, P., & Meesters, C. (2014). Small or big in the eyes of the other: On the developmental psychopathology of self-conscious emotions as shame, guilt, and pride. *Clinical Child and Family Psychology Review, 17*(1), 19–40.
https://doi.org/10.1007/s10567-013-0137-z

Nelson, N. L., & Russell, J. A. (2012). Children's understanding of nonverbal expressions of pride. *Journal of Experimental Child Psychology, 111*(3), 379–385.
https://doi.org/10.1016/j.jecp.2011.09.004

Parker, S. W., & Nelson, C. A. (2005). An event-related potential study of the impact of institutional rearing on face recognition. *Development and Psychopathology, 17*(3), 621–639.
https://doi.org/10.1017/S0954579405050303

Shariff, A. F., & Tracy, J. L. (2009). Knowing who's boss: Implicit perceptions of status from the nonverbal expression of pride. *Emotion, 9*(5), 631–639.
https://doi.org/10.1037/a0017089

Shimoni, E., Asbe, M., Eyal, T., & Berger, A. (2016). Too proud to regulate: The differential effect of pride versus joy on children's ability to delay gratification. *Journal of Experimental Child Psychology, 141,* 275–282.
https://doi.org/10.1016/j.jecp.2015.07.017

Strauss, E., & Moscovitch, M. (1981). Perception of facial expressions. *Brain and Language, 13*(2), 308–332.
https://doi.org/10.1016/0093-934X(81)90098-5

Sugase, Y., Yamane, S., Ueno, S., & Kawano, K. (1999). Global and fine information coded by single neurons in the temporal visual cortex. *Nature, 400,* 869–873.
https://doi.org/10.1038/23703

Sznycer, D. (2019). Forms and functions of the self-conscious emotions. *Trends in Cognitive Sciences, 23*(2), 143–157.
https://doi.org/10.1016/j.tics.2018.11.007

Takahashi, H., Matsuura, M., Koeda, M., Yahata, N., Suhara, T., Kato, M., & Okubo, Y. (2008). Brain activations during judgments of positive self-conscious emotion and positive basic emotion: Pride and joy. *Cerebral Cortex, 18*(4), 898–903.
https://doi.org/10.1093/cercor/bhm120

Taylor, M. J., Batty, M., & Itier, R. J. (2004). The faces of development: A review of early face processing over childhood. *Journal of Cognitive Neuroscience, 16*(8), 1426–1442.
https://doi.org/10.1162/0898929042304732

Taylor, M. J., McCarthy, G., Saliba, E., & Degiovanni, E. (1999). ERP evidence of developmental changes in processing of faces. *Clinical Neurophysiology, 110*(5), 910–915.
https://doi.org/10.1016/S1388-2457(99)00006-1

Todd, R. M., Lewis, M. D., Meusel, L.-A., & Zelazo, P. D. (2008). The time course of social-emotional processing in early childhood: ERP responses to facial affect and personal familiarity in a Go-Nogo task. *Neuropsychologia, 46*(2), 595–613.
https://doi.org/10.1016/j.neuropsychologia.2007.10.011

Tracy, J. L., Cheng, J. T., Robins, R. W., & Trzesniewski, K. H. (2009). Authentic and hubristic pride: The affective core of self-esteem and narcissism. *Self and Identity, 8*(2–3), 196–213.
https://doi.org/10.1080/15298860802505053

Tracy, J. L., & Robins, R. W. (2004). Putting the self into self-conscious emotions: A theoretical model. *Psychological Inquiry, 15*(2), 103–125.
https://doi.org/10.1207/s15327965pli1502_01

Tracy, J. L., Robins, R. W., & Lagattuta, K. H. (2005). Can children recognize pride? *Emotion, 5*(3), 251–257.
https://doi.org/10.1037/1528-3542.5.3.251

Tracy, J. L., Shariff, A. F., & Cheng, J. T. (2010). A naturalist's view of pride. *Emotion Review, 2*(2), 163–177.
https://doi.org/10.1177/1754073909354627

Williams, L. A., & DeSteno, D. (2008). Pride and perseverance: The motivational role of pride. *Journal of Personality and Social Psychology, 94*(6), 1007–1017.
https://doi.org/10.1037/0022-3514.94.6.1007

Williams, L. A., & DeSteno, D. (2009). Pride: Adaptive social emotion or seventh sin? *Psychological Science, 20*(3), 284–288.
https://doi.org/10.1111/j.1467-9280.2009.02292.x

Yang, L. Z., Jiang, Y., & Zhang, L. H. (2012). Development of a nonverbal behavior expression coding system for children's pride [In Chinese]. *Psychological Development and Education, 28*(3), 231–238.
https://doi.org/10.16187/j.cnki.issn1001-4918.2012.03.002

