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Review Paper

The Development of Non-Verbal Emotional Perception: A Review

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ABSTRACT

This paper explores the development of emotional perception and the subsequent variations resulting from culture and gender. Understanding how this variability alters the way we encode emotions forms the cornerstone of changes that take place during the developmental process and undermines the idea of universality for this cognitive domain.

Keywords: *Development, Non-Verbal Emotional Perception*

Understanding emotions displayed by other individuals is an essential component of social cognition and guides our social interactions. For younger children, becoming adept at perceiving emotions displayed by others gives them access to more information about their environment and allows them to have expectations and make predictions about it (Arsenio & Ford, 1985). Discerning and identifying non-verbal, affective cues is therefore highly evolutionarily adaptive, especially when children are faced with apparently adverse stimuli (Trnka et al., 2015). Thus, this ability forms an integral part of the child's early development. Non-verbal affective cues are not limited solely to facial expressions and also include gestures, body language and tone.

When contextualized in terms of culture, these affective expressions are not universal and differ culturally. Thus, this adds an additional layer to a child's processing mechanism which must not only discriminate between the different types of expressions but also account for cultural variation. Furthermore, gender too seems to be an influencing factor in the way we recognize emotions. Therefore, it is clear that these perceptual tasks require sufficient cognitive load and stands to reason that there must be some cognitive mechanism that mitigates this.

As previously discussed, the fact that emotion perception is exceedingly adaptive during early social interactions, has prompted the assumption that there is an innate ability to discriminate facial expressions. When infants are exposed to expressions, they can extract relevant information about certain features and give them affective meaning, thereby supporting the idea that this development must have a biological predisposition (Serrano et al., 1992). Human new-borns that are merely 36-hours-old are discriminated between facial expressions of happiness, sadness and surprise. Each emotion was displayed by a live model and it was found that visual fixation decreased as trials continued. However, when the face changed the visual fixation was reinstated. The study found changes in the neonate's facial

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movements that seemed to mimic the facial changes that the child observed (Field et al., 1982). This idea of a biological predisposition for the capacity to discriminate between facial expressions is also supported by the identification of analogous structures in the brains of human infants and chimps that prove the biological basis for the recognition of facial expressions.

However, although there is an inherent mechanistic component, there are also experience-based factors that influence its progress. There are certainly some components of facial expression processing that exist from birth, yet, experience affects the manifestation of this biological readiness (C. A. Nelson, 1987). In three-month-old infants recognition of emotion in a habituation based task involving their mothers and strangers was significantly better for their mothers, alluding to the fact that familiarity plays an important role in expression perception (Barrera & Maurer, 1981). External factors such as sex, socio economic status and verbal ability also affect its development (Herba & Phillips, 2004). Thus, it is clear that there are both innate and environmental influences on the development of facial emotion processing.

Over the first two years of a child's life, this process keeps developing but is still relatively rudimentary. Infants as young as three-month-olds were able to distinguish between smiling and frowning expressions displayed by both their mothers and strangers (Barrera & Maurer, 1981). By 4 months they can distinguish between positive and negative emotions expressed by a third party, as results from a looking-time based study showed. Not only this, but when these expressions are perceived in a naturalistic context, they are also able to respond in meaningful ways. This study shows a clear sensitivity to affective expressions (Montague & Walker-Andrews, 2001). Infants between the ages of 4-6 months were able to recognize and distinguish between expressions of fear, surprise and anger when displayed by multiple female models, an infant-controlled habituation-recovery procedure revealed. Infants were first habituated to images of various emotions after which they were shown new models demonstrating either the same expression they had been habituated to or a novel emotion. Additionally, it was found that infants looked longer at displaying anger and surprise than fear, as they are more useful in social situations (Serrano et al., 1992).

In 7-month-olds, a bottom-up process is involved in infants understanding the expression they see and then reacting to it. Rapid Facial Reactions (RFRs) serve as manifestations of the bottom-up processes and help the observer empathize with the individual they are observing. These RFRs are present from birth but are employed by 7- month-olds to react differently in response to happy and angry expressions, thereby suggesting that 7-month-olds cannot only distinguish between but also embody various facial expressions. This study relied on facial electromyography data to elicit these findings (Datyner et al., 2017). After 7-months but by 10-months of age children are able to recognize affective similarity in positive facial expressions when displayed by previously familiarized models. This study too used a habituation task followed by a novel face task (Ludemann, 1991). Further evidence from behavioral and neuroimaging studies shows that this development of emotion expression processing as well as the neural regions associated with it continue developing through both childhood and adolescence (Herba & Phillips, 2004).

There is irrevocable support for the notion that bodies, verbal cues, and gestures too serve as an important source of information about the affective states of those around us. Our the emotion recognition system relies on not only facial expression cues but also other body cues and integrates them to create a holistic representation of the emotion being displayed.

In fact, it was found that humans used information from isolated bodies, not faces, to anticipate the intense positive or negative emotion being displayed. When a compound of positive faces with negative bodies and vice versa was created and presented to the participants, participant's reactions and understanding of affects aligned with the emotion being displayed by the body (Aviezer et al., 2012). This finding was corroborated by a study that recorded electrical brain activity in response to a similar face-body affect mismatch and found that people were biased towards body-based emotional cues. When there is disagreement between the two simultaneously presented stimuli, a rapid neural mechanism comes into play that assesses the degree of agreement and relevance of the presented cues. These changes were visible in the occipital P1 component of the ERP waveform that is responsible for initial processing of faces. This electrophysiological finding is proof that affective information is integrated during an early stage of face processing (Meeren et al., 2005).

Delving deeper, the perception of multi-modal expressions of emotions - specifically body and voice-based emotions - is explored. Almost from birth, children are attuned to multimodal social signals. While visual scanning and acuity are limited at birth (Walker Andrews, 1997), infants rely on auditory and voice cues to abstract information from their environment. Babies scanned an adult's face for longer when they heard talking from it (Haith et al., 1977). They also turn towards certain sounds – thus integrating auditory and visual perceptions in order for auditory localization to occur (Castillo & Butterworth, 1981). While this system is primitive, its sophistication increases as children age.

Like the way facial emotion perception develops quickly over the first 6 months, studies show that the body emotion perception system too develops. As proposed by Walker Andrews (1997), children initially employ a perceptual discrimination process that later develops into the ability to identify. This is preceded by the detection of cues that potentially hold information of what the expression may be. Later they can engage in discrimination and recognition respectively. Zieber et al. (2014) conducted a series of experiments that aimed to outline the developmental trajectory of intermodal emotion perception from bodies and voices. The first experiment had exposed children to a nonverbal happy or sad vocalization along with the presentation of a static image of the corresponding body postures. 6.5-month-old infants were able to detect the congruence and assign affective value correctly to the nonverbal auditory stimulus. However, when 3.5-month-old infants were given the same test, they failed to match correctly. Despite using the same procedure but with dynamic body movements, 3.5-month-olds once again failed to correctly identify the body that matched the sound. Since 6-month-olds can perform these tasks accurately, but 3.5-month-olds cannot, the development must occur between these two periods.

Yet another study further narrowed down the developmental timeline. Heck et al. (2018) showed that 5-month-olds but not 3.5-month-olds were able to recognize emotions from bodies and match them to the correct video and voice they were correlated with. Contrarily to 5-month-olds, 3.5-month-olds relied on low-level stimulus cues rather than affect-based information when faced with body emotions and therefore could only discriminate between them. Even so, at 5 months of age children still rely on facial expressions presented in conjugation with vocalizations to make affective judgements. During the habituation process infants were habituated to a vocalization along with either the correct facial expression, incorrect facial expression, or a neutral visual stimulus. The experimental condition involved maintaining the slide while either varying or not varying the vocalization. In the case that there was a change, children increased their looking time

proving that they are able to discriminate between affective vocalizations (Walker-Andrews & Lennon, 1991).

An examination of ERPs in 4 and 8-month-olds revealed that 8-month-olds showed significant differences in the way they encoded happy and fearful bodies for both upright and inverted stimuli (Missana et al., 2014). The ERP data pinpoints neural regions involved in perception and attention and are used in that order during face processing. 8-month-olds showed left and right hemisphere activation in response to happy and fearful body expressions respectively with each correlating to approach and avoidance accordingly. These findings show that the brain too undergoes developmental tuning and becomes sensitive to body emotions (Missana & Grossmann, 2015). 3–5-year-olds were assessed on their ability to label emotion cues displayed in different conditions – face-only, posture-only or multi cue. They were able to identify emotions displayed by body, face, and body and face but did worse on vocal cue tests especially for non-sad vocalizations. These findings suggest that preschoolers primarily rely on visual aspects of affective expressions and later turn to vocal expressions (N. L. Nelson & Russell, 2011).

The research so far has focused on younger infants. Yet, there is evidence of pending development that is completed in late childhood. Videos of actors portraying four basic emotions through body movements were shown to a group of children aged 4-17 in both full light and point-light view. They were then asked to make a forced-choice and identify the emotion being displayed. Analysis showed that both age and lighting affected children's performance with younger children faring significantly worse than their older children. Even for adolescents though, perception of emotions solely from body language follows a nonlinear trajectory and is not fully mature. This implies a shift to different cognitive strategies once children reach adolescence (Ross et al., 2012). So, it is evident that finer nuances of non-facial emotion expression perception continue to develop well into late childhood and adolescence.

Analyzing this from a cognitive neuropsychological lens proves fruitful in revealing typical developmental paths by considering the differences in developmental trends observed in atypical or injury models. A growing body of literature narrows in on people with autism and their ability to perceive emotions displayed by others. Individuals with ASD were significantly less successful than controls at recognizing basic emotions displayed in both upright and inverted images. Most in the clinical group mistook fear for anger. A follow up experiment looked at the participant's ability to recognize emotions displayed exclusively by the mouth and eyes. Results showed a similar impairment as the first study. These results were analyzed and compared to multiple proposed hypotheses. Primarily, partial support for the configural processing hypothesis was evidenced by the consistent inability to distinguish between disgust and sadness and when the stimulus was inverted. Secondly, atypical amygdala functioning is indicated by the misrecognition of fear and anger (Wallace et al., 2008).

An integration of findings from people with ASD and amygdala damage further supported the latter hypothesis especially in cases that require not just perceptual level processing but also processing at a semantic level. The amygdala is the brain region implicated in understanding and processing emotional information, especially that which is to do with fear and threats. Using a labeling task as previously discussed, both individuals with autism and amygdala damage were able to pass basic recognition tasks but were unable to perceive emotions when the stimuli was more complex and consisted of only parts of faces (Castelli,

2005). Other studies also show discrepancies rooted in neural mechanisms. When children with ASD of 3 and 4 years of age were shown images of a novel woman displaying prototypic fear expressions, their neural mechanisms were atypical as disclosed by ERP data. Children with ASD either did not show or were late to show a difference in neural data on exposure to fear expression versus a neutral expression (Dawson et al., 2004). In terms of body-emotions, children with ASD performed equivalently to their typically developing peers as shown by a series of body-emotion recognition matching tests (Peterson et al., 2015). Given that children with ASD have differences in processing abilities depending on whether the stimulus is a face-emotion, or a body-emotion serves as testament to the fact that the two systems develop independent of one another although there may be overlapping brain regions involved.

It seems that emotion recognition and display are two sides of the same coin and therefore understanding emotion recognition warrants the understanding of the emotion being displayed. As humans, however, our affective expressions are not necessarily universal. When contextualized in terms of culture, some of our affective expressions seem to vary while others remain constant. Some facial expressions like pain are consistent throughout cultures. Using a Facial Action Coding System, facial expressions were measured during both painful and pain free moments. Similar facial expression was demonstrated across all individuals proving that pain expressions are universal across cultures (Prkachin, 1992).

Other emotions are displayed differently across cultures. In an experiment that involved sighted and blind athletes from the Olympic and Paralympic Games respectively, researchers looked at emotional displays of shame and pride. It was found that pride was displayed in the same way for both athletes from over 30 different nations. However, while shame was displayed in the prototypical way by blind individuals, sighted individuals differed in their expression of shame, pointing at some amount of cultural moderation. It was found that individuals from individualistic cultures were less pronounced in their displays of shame while the opposite was true for those from collectivist cultures (Tracy & Matsumoto, 2008). While there seems to be some similarities in facial expression that persist over cultures, there is also significant cultural variation.

Likewise, there are cross-cultural differences in the way we display body language-based expressions of emotion (de Gelder & Huis in 't Veld, 2016). Findings show a link between body posture and expected facial emotions in adults and older (N. L. Nelson & Mondloch, 2017). A culture-based difference in the way humans express emotions implies that there must be implicit differences in our discrimination of emotions expressed by individuals from different cultures. Thus, while some emotional displays remain constant throughout cultures, others may vary.

Adding an additional layer of culture, further increases our cognitive load on an already cognitively taxing task, thereby demanding the existence of certain attenuating mechanisms. This claim is supported by studies done with both adult and infant participants. It was found that a sort of perceptual narrowing occurs that makes our emotion perception ability more race specific. This 'narrowing' forms the basis for the race-based bias seen in adults. 5-month-old and 9-month-old were tested using behavioral and electrophysiological methods. Early in their first year, children consistently recognize emotions displayed by same and other race individuals. However, results showed that as they transitioned from 5-month-olds to 9-month-olds, their perceptual processing of other-race face emotions is impaired until there is clearly better performance for same-race face expressions.

These changes are neuronally (Vogel et al., 2012) and cognitively realized as well (Engelmann & Pogosyan, 2013). A cross-cultural study observed that positive affective displays of varying intensity are cognitively encoded differently across cultures. Participants were from Russia, Japan and America and it was found that the way the emotions were displayed influenced the mental representation of that emotion. Therefore, by looking at the way people from these different cultures display emotions, their intensity prototype differed and so did their mental representations. Furthermore, eye tracking data show that people from different cultures attend to different facial features while trying to discern emotions. Yet Another study derived computational data by using a platform that integrates generative grammars with visual perception to recreate participant's mental representations of the six main human emotions. While Westerners used the same or similar facial expression to represent an emotion, Easterners did not. Secondly, Easterners use distinct eye movements in response to intense emotions (Jack et al., 2012).

Participants from two opposing cultures- US and Himba – were made to sort out images based on the displayed emotions. US participants sorted the emotions under the assumption that there exist universal features while participants from Himba culture did not. However, when additional cues were presented to the participants, both cultures aligned more closely to the universal trend although there was still some remnant cultural variation (Gendron et al., 2014). Emotions serve as a driving force in our social interactions and therefore recognition of emotions is cultural variation.

But does this cultural variation in emotion perception extend to non-face displays of emotion as well? A study involving 3–7-year-old African American and European American participants investigated in-group emotional affects. Each participant was presented with photographic stimuli of face only, face and body or body only emotional displays. European Americans were found to be more accurate when recognizing emotions displayed by their own group while African Americans did equally well for either group. Culture may have some implication on the way we perceive laughs and screams too, a study with adult participants from Western cultures and participants from a remote, isolated Namibian village showed. Participants were exposed to the stimuli and were made to recognize the emotion being displayed. While basic emotions were easily identified by both cultures, other subtler emotions had a strong in-group bias. Additionally, most negative emotional vocalizations could be identified across cultures, but most positive emotions had a culture-specific aspect. Data from ERP readings demonstrated that when static images if either African American or Caucasian faces displaying either a positive or negative facial expression were paired with either laughing or crying sounds, there was a same race bias seen in 9-month-olds but not 5-month-olds. There was also a neuronal shift between this period from a focus on anterior ERP attention to posterior ERP attention. Thus, the improvement of abilities during this age range can be seen via changes in the brain as well (Vogel et al., 2012).

In terms of gender too, research illustrates differences in both the way people display and recognize emotions. These differences can be attributed to differences in socialization methods for males and females or can be reflective of adaptations due to innate gender differences in temperament or adaptations to socio-cultural pressures. In general, with development, boys tend to curtail their expressions of most emotions while girls inhibit the expression and recognition of those emotions that are considered socially unacceptable such as anger (Brody, 1985). A meta-analytic review paper culminated findings from numerous papers to derive conclusions on emotion expression based on gender at different stages of the developmental process. Primarily they found that these differences were highly context

and situation dependent. Girls showed more positive and internalized emotions that boys and boys engaged in more externalized emotional displays of emotions like anger. As age increased, these gender differences too increased. Boys showed more externalized emotions in early and middle childhood, but this reduced to even less than girls in adolescence (Chaplin & Aldao, 2013). Again, it is important to note the heavy influence of cultural context and culturally determined gender roles in shaping emotional expressivity in children. Caretakers align their interactions with their children with the cultural values laid out within their societies thereby altering their child's behavior – in this case emotional expression (Brody, 2000).

Whether these gender differences percolate even when it comes to recognizing emotions is still under review and highly context dependent. A study carried out in Pakistan involving participants of various ages ranging from children to older adults failed to show any gender differences in emotion recognition for any of the age groups (Khawar et al., 2014). However, other studies show contradictory results, raising the question that this study may be the exception. Another study observed that girls performed better on facial emotion discrimination tasks which could be due to compensatory cognitive mechanisms (Kothari et al., 2013). A study with older participants – children of ages 7-10 years old – had results that social adjustment determined emotional recognition accuracy for girls but not for boys. For girls, this effect was seen specifically for the recognition of surprise. Therefore, although emotion recognition was a function of social adjustment, the interaction was regulated by both the gender and emotion (Leppänen & Hietanen, 2001).

Understanding emotional display and recognition is clearly a preliminary step to understanding human social interactions and therefore is an integral developmental ability. While both facial-emotion recognition and body-emotion recognition begin developing at an early age, both continue developing well into late childhood and even adolescence. Evidence from atypical models show that both develop independently of one another and utilize different neuropsychology, although some brain regions involved may overlap. When culture is also considered, significant variation is observed. In terms of display, some emotion displays like those of pain remain consistent universally while others such as shame may differ across cultures. Given that emotions are displayed differently by people from different cultures, it implies that emotional recognition must vary through cultures as well. When it comes to recognizing both types of emotional displays, there seems to be some sort of perceptual narrowing that takes place. The resultant in-group bias implies that for certain emotions, we are better at recognizing them when they're displayed by people from one's own cultural group. This perceptual narrowing was seen early on in the developmental process, but not nearly enough that it should be considered innate.

However, research in this field is not nearly complete and is lacking in some spheres. Future directions should delve deeper into the perceptual narrowing that occurs and why it takes place. Since it doesn't exist from birth, more information about when it begins to develop would be important for understanding the purpose it serves. Furthermore, as we live in a constantly integrating world where babies are exposed to numerous cultures, I wonder how this narrowing would be affected. As discussed priorly, most research relies on children that are brought up exclusively in a culture and therefore lack exposure that would lead to nuanced results. In a broader sense, available research is disproportionately focused on facial emotions but as seen by the studies mentioned before, non-facial emotions too play an extensive role in our emotional display repertoire and therefore require an equivalent amount of exploration. Specifically, there is significantly less information available about cultural

variations in recognizing non-face emotions. Follow up research should also look into gender differences in emotion recognition during the developmental period in order to pin-point how cultural context may lead to a gender based cognitive bifurcation during development. Available research shows that there are clear gender differences in the way we encode emotions, yet there is no information on the developmental manifestations of these differences. Given that a perceptual narrowing occurs for those from one's own culture, it can be assumed the social normative pressures lead to such changes based on gender that occur during the developmental process in a similar way.

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Conflict of Interest

The author(s) declared no conflict of interest.

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