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Beyond Language in Infant Emotion Concept Development

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Abstract

The process by which emotion concepts are learned is largely unexplored. Hoemann, Devlin, and Barrett (2020) and Shablack, Stein, and Lindquist (2020) argue that emotion concepts are learned through emotion labels (e.g., "happy"), which cohere variable aspects of emotions into abstract, conceptual categories. While such labeling-dependent learning mechanisms (supervised learning) are plausible, we argue that labeling-independent learning mechanisms (unsupervised learning) are also involved. Specifically, we argue that infants are uniquely situated to learn emotion concepts given their exceptional learning abilities. We provide evidence that children learn from complex, irregular input in other domains (e.g., symbolic numbers) without supervised instruction. Thus, while labels undoubtedly influence emotion concept learning, we must also look beyond language to create a comprehensive theory of emotion concept development.

Keywords

emotions, infants, language, supervised learning, unsupervised learning

We agree with Hoemann et al. (2020) and Shablack et al. (2020) that emotion concepts are learned, rather than innately specified. However, the process by which emotion concepts are learned is largely unexplored. Both commentaries argue that emotion concepts are learned through emotion labels (e.g., "happy"), which cohere variable aspects of emotions into abstract, conceptual categories. While such labeling-dependent learning mechanisms (*supervised learning*) are plausible, we argue that labeling-independent learning mechanisms (*unsupervised learning*) are also involved. Examining both types of learning mechanisms is needed for a comprehensive theory of emotion concept development.

Both commentaries contend that individual instances of an emotion category (e.g., "anger") lack statistical regularity in their physiological and perceptual features (see also L. F. Barrett, Adolphs, Marsella, Martinez, & Pollak, 2019). Since these features provide little information about category membership, infants ostensibly learn emotion concepts through the emotion labels in their environments (Hoemann, Wu, et al., 2020—supervised learning. Labels (e.g., "Aw, you fell down! Don't cry! Are you sad?") are thought to "tag" various eliciting events (e.g., falling down), expressive behaviors (e.g., crying), and goal-based functions (e.g., to receive comfort) as members of a category (e.g., "sadness"). As Shablack et al. (2020) highlight, labels might serve this function in both implicit statistical learning and explicit learning/teaching. Further, not every occurrence of an emotion need be labeled, as infants can form categories with intermittently labeled exemplars (i.e., *semisupervised learning*; LaTourrette & Waxman, 2019).

While supervised learning of emotion concepts is plausible, this hypothesis rests on two yet untested assumptions. First, it assumes that infants' emotional environments lack sufficient statistical structure for emotion concepts to be learned without emotion labels. However, infants may be uniquely situated to learn emotion concepts. Specifically, caregivers may (a) exaggerate emotions, comparable to infant-directed speech ("motherese"; Gleitman, Newport, & Gleitman, 1984; Trainor, Austin, & Desjardins, 2000) and actions ("motionese"; Brand, Baldwin, & Ashburn, 2002; Brand & Shallcross, 2008), or (b) display a limited set of mostly positive emotions (Malatesta et al., 1989; Malatesta & Haviland, 1982). Together, this style of emotional communication ("emotionese") may facilitate learning (Casasola, 2005; Koterba & Iverson, 2009; Thiessen, Hill, & Saffran, 2005). Further, as exceptional category learners (Madole & Oakes, 1999; Mareschal & Quinn, 2001), infants might be particularly sensitive to the (limited) regularities in emotion categories, including facial features (Duran, Reisenzein, & Fernández-Dols, 2017) and regulatory functions (K. C. Barrett, 2020). Infant learning is also constrained by innate or acquired expectations/biases (e.g., limited working memory, perceptual narrowing) that guide infants to learn meaningful knowledge in the face of highly variable input (Oakes & Rakison, 2019).

Second, the supervised learning hypothesis assumes that caregivers' emotion labels neatly scaffold infants' emotional environments into categories (L. F. Barrett, 2017; Hoemann, Xu, & Barrett, 2019). However, caregivers' naturalistic emotion talk is likely infrequent (Dunn, Bretherton, & Munn, 1987; Malatesta & Haviland, 1982). Infants neither reliably produce nor understand "basic" emotion labels (e.g., "happy") prior to 24 months of age (Ridgeway, Waters, & Kuczaj, 1985; Ruba, Meltzoff, & Repacholi, 2019, 2020a, 2020b). This delayed acquisition (relative to object and verb labels; Fenson et al., 1994) likely reflects caregivers' relatively limited use of emotion labels (Ruba, Kalia, & Wilbourn (under review). Why is she happy? Maternal discrete emotion talk and infant emotion vocabulary development), or the difficulty inherent in learning such abstract terms (Ruba, Harris, & Wilbourn (under review). Examining infants' ability to map labels to facial configurations; Shablack, Becker, & Lindquist, 2019). Therefore, it is unclear whether caregivers use emotion labels with sufficient regularity to support supervised (or semi-supervised) emotion learning.

Together, this evidence suggests that unsupervised learning also influences emotion concept development (see also Plate, Wood, Woodard, & Pollak, 2019). In both supervised and unsupervised learning, infants observe relations between expressive behaviors, eliciting events, and goal-based functions. However, in unsupervised learning, these instances need not be "tagged" with a label. In this way, emotion concepts are founded on the statistical regularities in infants' emotional environments (Ruba & Repacholi, 2019), rather than on emotion labels (Hoemann et al., 2019; Lindquist & Gendron, 2013).

Both commentaries (Hoemann et al., 2020; Shablack et al., 2020) argue that unsupervised learning of emotion concepts is perhaps impossible given the complexity and irregularity of emotions. However, such unsupervised learning feats exist in other developmental domains. For example, despite the incredibly complex linguistic environment (Frost, Armstrong, & Christiansen, 2019; Saffran & Kirkham, 2018), infants are sensitive to and learn from regularities in linguistic input (Marcus, Vijayan, Bandi Rao, & Vishton, 1999; Maye, Werker, & Gerken, 2002; Saffran, Aslin, & Newport, 1996). By their second birthday, infants have acquired hundreds of words in their native language from mere exposure (Aslin, 2017; Kuhl, 2004). Further, there are many irregularities in the symbolic number system, and infants seldom see or hear three-digit number words (e.g., "518"; Fuson & Kwon, 1992; Levine, Suriyakham, Rowe, Huttenlocher, & Gunderson, 2010). Nevertheless, by observing the multiple predictive patterns in the surface structure of numbers (Yuan, Xiang, Crandall, & Smith, 2020), preschoolers learn to map spoken multidigit number words to their written forms (Mix, Prather, Smith, & Stockton, 2014; Yuan, Prather, Mix, & Smith, 2019). In sum, children learn from complex, irregular input (i.e., language, symbolic numbers) without supervised instruction, in order to make predictions about their environment (Saffran, 2020). Emotion concepts are possibly learned in a similar fashion, allowing infants to make predictions and inferences about their emotional environments beyond simple affective dimensions (i.e., valence, arousal).

We commend Hoemann et al. (2020) and Shablack et al. (2020) for outlining clear hypotheses for the supervised learning of emotion concepts. Such a perspective has been missing from the emotional development literature. Still, these hypotheses are largely driven by inferences from adult-centric research, and thus neglect the unique complexities of infant development (see

also K. C. Barrett, 2020; Buss, Cole, & Zhou, 2019; D'Arms & Samuels, 2019). Children are exceptional learners (Gopnik, Griffiths, & Lucas, 2015; Gopnik et al., 2017; Plebanek & Sloutsky, 2017), and while labels undoubtedly influence emotion concept learning (Ruba et al., 2020a; Ruba & Repacholi, 2020), we must also look beyond language to create a comprehensive theory of emotion concept development.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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