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How Do Children Learn Novel Emotion Words? A Study of Emotion Concept Acquisition in Preschoolers

Holly Shablack, Misha Becker, and Kristen A. Lindquist
University of North Carolina at Chapel Hill

Understanding emotion words is vital to understanding, regulating, and communicating one's emotions. Yet, little work examines how emotion words are acquired by children. Previous research in linguistics suggests that children use the sentence frame in which a novel word is presented to home in on the meaning of that word, in conjunction with situational cues from the environment. No research has examined how children integrate these cues to learn the meaning of emotion adjectives (e.g., "happy," "sad," "mad"). We conducted 2 studies examining the role of sentence frame and situational context in children's (ages 3–5) understanding of the meanings of novel words denoting emotions. In Study 1 (N = 135) children viewed a conversation wherein a novel "alien" word was presented in 1 of 3 sentence frames that varied in how likely the word was to denote an emotion (i.e., *is daxy, feels daxy,* or *feels daxy about*). Children selected the image that represented the meaning of the word in a picture-pointing task. Images depicted aliens experiencing an emotion, a physical state, or performing an action. In Study 2 (N = 113) situational context was added via cartoons depicting an emotional scenario. Findings suggest that children are more likely to associate emotion images with a novel word with increasing age, more informative sentence frames, and when the situational context implies that an emotion is present. This provides important insight on how educational and clinical settings can use language and situational context to aide in emotion understanding.

Keywords: emotion development, language, syntax, emotion concepts, concept acquisition

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Understanding one's own and others' emotions is crucial to social communication, interpersonal relationships, emotion regulation, and well-being (Eisenberg, Sadovsky, & Spinrad, 2005; Hagelskamp, Brackett, Rivers, & Salovey, 2013; Kashdan, Barrett, & McKnight, 2015; Lindquist & Barrett, 2008; Lindquist, Satpute, & Gendron, 2015; Twenge, Catanese, & Baumeister, 2003). Greater understanding of emotions in childhood predicts later academic and interpersonal success (for reviews see Lindquist, Gendron, & Satpute, 2016; Shablack & Lindquist, in press). Moreover, multiple forms of psychopathology are characterized by difficulties in understanding emotions, such as autism (Baron-Cohen & Wheelwright, 2004; Baron-Cohen, 1991; Dapretto et al., 2006; Wang, Dapretto, Hariri, Sigman, & Bookheimer, 2004), depression (Berenbaum & Oltmanns, 1992; Joormann, 2010; Murphy et al., 1999; Phillips, Drevets, Rauch, & Lane, 2003), and anxiety (Etkin & Wager, 2007; Mennin, McLaughlin, & Flanagan, 2009; Salters-Pedneault, Roemer, Tull, Rucker, & Mennin, 2006). It is thus important to understand the mechanisms by which some people gain a complex understanding of emotions, whereas others fail to.

One hypothesis is that a complex understanding of emotions is learned, primarily during early development via discourse with caregivers (Castro, Halberstadt, Lozada, & Craig, 2015; Dunsmore & Halberstadt, 1997; Garrett-Peters, Castro, & Halberstadt, 2017; Halberstadt & Lozada, 2011; Shablack & Lindquist, in press.; Weinberg, Tronick, Cohn, & Olson, 1999). In this view, interactions with caregivers, but particularly emotion word use by caregivers, helps children to acquire a rich cache of knowledge about the emotion concepts most relevant to their culture (Campos, Frankel, & Camras, 2004; Denham, Zoller, & Couchoud, 1994;

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Holly Shablack, Department of Psychology and Neuroscience, University of North Carolina at Chapel Hill; Misha Becker, Department of Linguistics, University of North Carolina at Chapel Hill; Kristen A. Lindquist, Department of Psychology and Neuroscience, University of North Carolina at Chapel Hill.

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Correspondence concerning this article should be addressed to Holly Shablack, Department of Psychology and Neuroscience, University of North Carolina at Chapel Hill, 235 East Cameron Avenue, Chapel Hill, NC 27599. E-mail: hshab@live.unc.edu

Ellis, Alisic, Reiss, Dishion, & Fisher, 2014; Fivush, Brotman, Buckner, & Goodman, 2000; Fivush, Haden, & Reese, 2006; Fogel et al., 1992; Halberstadt, Denham, & Dunsmore, 2001; Pons, Harris, & de Rosnay, 2004). Indeed, research in cognitive science suggests that words help infants, children, and adults acquire and use concepts of all kinds (Lupyan, 2012a, 2012b; Xu & Kushnir, 2013). In particular, words facilitate the acquisition of socially shared concepts such as emotions (Doyle & Lindquist, 2018), color (Steels & Belpaeme, 2005), and spatial relations (Casasanto, 2008; Casasanto & Bottini, 2014) in adults. Yet the mechanisms by which children learn emotion concepts and their labels remains relatively unknown. Unlike object concepts (e.g., *tiger*, *table*), which are concrete, stable, and typically labeled by nouns, emotion concepts are abstract, transient, and typically labeled by adjectives, which makes them a difficult class of concepts to learn labels for (Gentner, 1982; Pinker, 1984). By combining research in the development of emotion and psycholinguistics, the present studies assess for the first time how children might learn to associate novel words with emotion concepts. We hypothesize that like certain other lexical categories, children use the syntactic structure of language to infer the meanings of novel adjectives labeling emotion concepts. In addition, based on prior research on emotion concept understanding (Kayyal, Widen, & Russell, 2015; Widen & Russell, 2010, 2011) we hypothesize that situational cues from the environment will be needed to understand that novel adjectives denote emotion concepts.

The Role of Language in Emotion Development

Many psychological models of emotional development argue that the ability to experience, perceive, and ultimately understand specific emotion concepts follows a developmental trajectory and is learned through social relationships and verbal communication between children and caregivers (Castro et al., 2015; Dunsmore & Halberstadt, 1997; Garrett-Peters et al., 2017; Halberstadt & Lozada, 2011; Shablack & Lindquist, in press; Weinberg et al., 1999). In this view, infants start life with the ability to experience in their own bodies and perceive in others very basic feelings such as agitation and excitement (Bridges, 1932) or pleasantness and unpleasantness (Camras, 1992; La Barbera, Izard, Vietze, & Parisi, 1976; Lewis & Brooks, 1978; Russell & Bullock, 1985, 1986; Widen, 2013). It is hypothesized that over time, infants and children learn to make more fine-grained discriminations among these basic feelings. According to psychological constructionist approaches, concept knowledge about emotions is what ultimately helps children to learn to differentiate between different types of unpleasantness (e.g., *fear* vs. *anger*) or different types of pleasantness (e.g., *joy* vs. *pride*; Barrett, 2006, 2013; Barrett & Russell, 2015; Lindquist, 2013; Russell, 2003).

One perspective is that language helps children to acquire emotion concept knowledge because words serve as "essence placeholders" that cohere together instances (e.g., feeling aggressive, feeling like one's goals are blocked, feeling one's heart beating more quickly) as members of the same emotion category (e.g., anger; for a review, see Lindquist, MacCormack, & Shablack, 2015). This hypothesis shares much in common with hypotheses about the role of language in the acquisition of other concept types (Lindquist, MacCormack et al., 2015; Lupyan, 2012a, 2012b; Xu & Kushnir, 2013). It suggests that as children develop a larger emotion vocabulary, they develop more nuanced emotion concept knowledge and are thus able to perceive, express and experience a wider range of emotions.[1]

There is ample evidence to suggest that discourse with parents about emotions predicts children's greater emotional perception and understanding. For instance, correlational evidence suggests that as children age, emotion word knowledge increases (Bretherton & Beeghly, 1982; Ridgeway, Waters, & Kuczaj, 1985; Wellman, Harris, Banerjee, & Sinclair, 1995) as does performance in emotion perception tasks (Astington & Jenkins, 1999; Cutting & Dunn, 1999; Harris, De Rosnay, & Pons, 2005; Wellman et al., 1995). Furthermore, in 3- to 6-year-olds, general verbal ability (when controlling for age, attachment security, and gender) is an important predictor of children's ability to understand the emotions of others (de Rosnay & Harris, 2002; de Rosnay, Pons, Harris, & Morrell, 2004; Pons, Lawson, Harris, & De Rosnay, 2003). When using emotion words more specifically, toddlers initially describe their own feelings and the feelings of others in broad valenced terms by using general words such as *happy* and *sad* or *mad*. Yet by age 5 they additionally use words such as *afraid*, *surprised*, and *disgust* to describe a more nuanced range of emotional states (Widen & Russell, 2003). This effect appears to go beyond mere labeling, as children's ability to perceptually identify emotional facial expressions in a nuanced manner increases as emotion labeling ability increases. For instance, early in toddlerhood, children tend to use the words *happy* and *sad*[2] in daily discourse, and correspondingly can only reliably differentiate pleasant and unpleasant facial expressions from one another. Yet, around the time that children begin to use the words *anger* and *fear* in daily discourse to differentiate between different negative states, they also become able to perceive these negative emotions on faces (i.e., distinguish anger from fear) in perceptual sorting tasks (Widen & Russell, 2008). Importantly, asking children to match emotional facial expressions to words, as opposed to other facial expression exemplars, facilitates children's performance, even

[1] Psychological constructionist models of emotion stand in contrast to "basic emotion" approaches that assume that certain emotions are innate, such that children are able to experience in their own bodies and perceive in others discrete emotion concepts such as *anger, disgust, fear, happiness, sadness*, and *surprise* from birth (Ekman, 1992; Ekman & Cordaro, 2011; Izard, 2007; Panksepp, 1998). Although a prominent view, there is relatively little empirical support for the idea that infants and young children reliably perceive these emotions in others or themselves; the evidence is more consistent with the hypothesis that infants and children can differentiate between dimensions such as valence and develop an understanding of different emotion categories over early childhood (Ruba & Repacholi, in press; Shablack & Lindquist, in press; Widen, 2013). Although some basic emotion views acknowledge a role for learning in emotion understanding and experience, they stipulate that language itself is unrelated to emotion save for communication (Ekman & Cordaro, 2011). Nonetheless, these approaches would require that children need to learn how to communicate about emotions with words, a task which requires mapping experienced concepts to word forms during early development.

[2] Whereas some children use the word *sad* to label negative states, others use the word *mad* instead (Widen, 2013). Nonetheless, most children at this age only reliably use two words for emotion, meaning that if they use *happy* and *sad,* they do not also use *mad* (and vice versa). It is unknown why this idiolectal difference in use of *sad* versus *mad* occurs, but one possibility is that this difference could be a product of socialized gender stereotypes (Plant, Hyde, Keltner, & Devine, 2000), whereby parents use the term *sad* more with girls and *mad* more with boys when explaining emotions (Fivush, 1991; Fivush et al., 2000).

among children as young as 2-years-old (Russell & Widen, 2002a, 2002b).

These findings suggest that caregivers help children to label their own emotional states and the emotional states of others in an effort to scaffold their acquisition of knowledge about the emotion concepts relevant to the present context (Campos et al., 2004; Denham et al., 1994; Ellis et al., 2014; Fivush et al., 2000, 2006; Fogel et al., 1992; Halberstadt et al., 2001; Pons et al., 2004). However, very little research has assessed how children learn that a word denotes an emotion concept in the first place. This is an important next step in understanding the relationship between language and emotion and is the purpose of the present studies.

The Role of Linguistic Cues in Word Learning

Much of the experimental work on children's vocabulary development focuses on how children acquire words for object concepts, which are primarily labeled by nouns (Bloom, 2000; Gentner, 1982; Huttenlocher & Smiley, 1987; Markman, 1990). This emphasis is logical, as children's earliest vocabulary items are largely nouns that label people and basic objects (Bates et al., 1994). However, words of different lexical categories (verbs, adjectives, etc.) tend to have very different kinds of meanings and are learned in very different ways. For instance, verbs often label actions and events, and adjectives, which modify nouns, typically label properties or attributes. Emotions are internal states that are most frequently labeled by adjectives in everyday speech (Shablack, 2017), and verbs and adjectives are conceptually more complex than nouns (Gentner, 1982). Moreover, while caregivers may label salient objects for children ostensively (e.g., "Look! That's a dog!"), caregivers do this only rarely (if at all) with properties and states of being (Gleitman, 1990).

As a product of their abstract and complex nature and lack of ostensive instruction, verb and adjective meanings are less straightforward than noun meanings for children to learn, and they are learned later (Gentner, 1982). An influential approach called the *syntactic bootstrapping hypothesis* (Fisher, Gleitman, & Gleitman, 1991; Gleitman, 1990; Gleitman, Cassidy, Nappa, Papafragou, & Trueswell, 2005; Naigles, 1996) points to the role of syntactic structure in cueing the meanings of these types of words; work within this approach has focused mainly on verbs. Both within a language and across different languages, the number of noun phrases (i.e., *arguments*) that occur with a verb in a sentence is related in highly regular ways to the lexical meaning of the verb. Children can thus use these arguments to infer the meaning of verbs (see Table 1 for examples). For instance, the novel verb *gorp* in the sentence *Bill gorped Jane a rose* could not mean something like "sleep" or "kiss" (note the oddness of **Bill slept Jane a rose*).[3]

The syntactic bootstrapping hypothesis has been tested (Fisher et al., 1991; Gleitman, 1990; Gleitman et al., 2005; Naigles, 1990, 1996) by presenting young children with novel verbs used in particular sentence "frames" (e.g., with one vs. two arguments). Children are then asked to point to, or their eye gaze is tracked toward a visual image depicting the relevant action (Fisher, 2002; Hirsh-Pasek & Golinkoff, 1996; Naigles, 1990; Yuan & Fisher, 2009). The methodology has been adapted to test learners' interpretations of not only verbs denoting observable actions but also relatively more abstract kinds of verbs, such as those that could have a meaning like *think* or *seem*, or to abstract adjectives such as *easy* (Becker, 2006, 2014, 2015; Becker & Estigarribia, 2013; Papafragou, Cassidy, & Gleitman, 2007). In some cases, such as for abstract verbs such as *think*, the sentence frame is even more informative than extragrammatical situational context (what is going on in the world when a particular verb is uttered) for cueing children to the predicate's meaning (Gleitman et al., 2005; Papafragou et al., 2007). However, children can draw such inferences about more abstract verbs only after age 4 (Becker, 2006, 2014).

Although syntactic bootstrapping is a likely mechanism by which children learn predicate meanings, there is little work examining the relative role of sentence frame in the acquisition of adjectives as a lexical category (Booth & Waxman, 2003, 2009; Syrett & Lidz, 2010). No work to our knowledge looks at the application of this approach to novel emotion concepts. Insofar as emotions are most often labeled by adjectives (*happy, sad, mad,* etc.; Shablack, 2017), children should be able to use syntactic bootstrapping to understand the meaning of novel emotion words and concepts. On the other hand, emotions are highly situated concepts in which people are responding to real or imagined events in the world around them (Wilson-Mendenhall, Barrett, Simmons, & Barsalou, 2011). As such, access to details about the context in which emotions are occurring (Harris, Johnson, Hutton, Andrews, & Cooke, 1989; Kayyal et al., 2015; Widen & Russell, 2010, 2011, 2013) may influence a child's inferences about the meaning of emotion concept labels. In particular, situational details from the immediate context, such as information about the causes of a certain emotion (e.g., loss) and what a person did as a consequence (e.g., cry) help children to accurately identify the emotion concept being described in a story, often above and beyond other perceptual information such as facial expressions (Kayyal et al., 2015; Widen & Russell, 2010, 2011). When the evidence is taken together, it is likely that children use both linguistic information (sentence frames) and situational cues from the environment (causes and consequences of emotion) in the acquisition of emotion words. Yet no work to our knowledge has assessed how children use syntactic structure in combination with situational context to learn the meaning of emotion concept labels.

Present Studies

We conducted two studies examining the extent to which sentence frames and situational context impact children's (aged 3–5) understanding that novel words denote emotion concepts. In Study 1, we manipulated the sentence frame a novel word was presented in to examine whether sentence frame alone helps children perceive that a word denotes an emotion concept as opposed to other predicate meanings such as a physical state or an action, and at what age this occurs. Sentence frames were manipulated by presenting a novel word in a verb structure that limits the possible meaning of the word. For example, when presenting a novel word (*binty*) as the sole complement of the verb *is* (i.e., *Susan is binty*), the meaning of *binty* is fairly unlimited. As an adjective *binty* can denote an emotion, such as "happy," a physical state, such as "cold," or even a physical characteristic, such as "tall" (note the grammaticality of *Susan is happy/cold/tall*). However, if *binty* is the complement of the verb *feels* (i.e., *Susan feels binty*), the

[3] Linguists use the symbol * to indicate ungrammaticality or unacceptability.

Table 1
Examples of Syntactic Structure Cueing Possible Meaning

Number of arguments (NP)	Examples	Verb denotation
Single NP	John slept; Mary is running	An action/event that an individual engages in by themselves
Two NPs	Sue kissed the baby; Kevin hugged his friend	An action/event that one individual does to another (i.e., the object is affected by the action)
Three NPs	Katrina gave Emily a pen; Roger told Marvin a story	Generally means something about transfer or communication

meaning of *binty* can no longer denote a physical characteristic like "tall" (excepting figurative uses of this adjective), though it could still denote either an emotion ("happy") or a temporary physical state ("cold"; thus: *Susan feels happy/cold/*tall*). Finally, if *binty* is used within a sentence like *Susan feels binty about something*, the meaning of *binty* is further restricted to denoting a mental or emotional state; it can no longer denote a physical state like "cold" (*Susan feels happy/*cold/*tall about something*). Therefore, we predicted that if children rely exclusively on linguistic cues, the likelihood for a child to determine that a novel word is an emotion concept label would increase as the sentence frame becomes more restrictive.

In Study 2, we examined the extent to which the sentence frame helped children acquire the meaning of novel emotion concepts when that acquisition was also scaffolded by situational context. We manipulated the sentence frame as in Study 1 and also told children a "background" story that highlighted the causes and consequences of an experience that the main character underwent. For example, prior to a sentence such as "Palooza feels binty," children heard a story about a character receiving a gold star for her drawing, providing situational context for what she was feeling and why. Study 2 thus examined whether the sentence frame a word appeared in is especially useful for understanding the meaning of a novel emotion concept when that word appears in a relevant situation.

Across both studies we hypothesized that older children would be more likely to perceive a novel word as an emotion concept label given appropriate linguistic and situational cues; however, as we hypothesize that sentence frames and situational context provide specific cues in concept acquisition and word disambiguation, we predicted age interactions with sentence frame (Study 1), especially in the presence of situational context (Study 2).

Study 1

In Study 1, we predicted that children would use sentence frame as a cue for their understanding of novel emotion words. Specifically, if children use sentence frame alone to drive emotion concept word acquisition, then children would especially perceive a novel word as labeling an emotion when it is presented in a more restrictive sentence frame (e.g., *feels* or *feels about*). Mirroring past work on syntactic bootstrapping (e.g., Papafragou et al., 2007) we predict that children would become more adept at using the sentence frame as age increases.

Method

Participants. One hundred sixty-two children participated in the study at the Museum of Life and Science in Durham, North Carolina. Children who did not meet our a priori inclusion criteria were excluded from further analysis. Nine children were not within our desired age range (i.e., were siblings of other children who participated or were found to not be in the proper age range following parent report). Three additional children were removed from the analysis because they lived in households in which languages other than English were spoken greater than 50% of the time; we reasoned that in the case of bilingual children our sentence frame manipulation would be less effective since those children might regularly experience more varied sentence frames. Two children were removed from analysis because their parent/guardian reported that they had a learning disability on the parent questionnaires. An additional 12 children started, but did not complete the video task because they either stopped participation part way through ($n = 9$) or failed the screening task ($n = 3$). One child completed an incorrect survey due to experimenter error and is not included. The final sample consisted of 135 ($M_{age} = 3.97$, $SD_{age} = .79$; 72 female) children: 44 3-year-olds (25 female), 51 4-year-olds (27 female), and 40 5-year-olds (20 female).[4]

Children completed the study individually with a single experimenter. A second experimenter observed the interaction and answered any parent/guardian questions. Parents and/or legal guardians completed a packet of questionnaires about their child's home life and development. Sixteen individuals did not report family income; of the 119 who did, 19.3% reported a household income <$70,000; 21% reported between $70,000 and $100,000; 29.4% reported between $100,000 and $150,000; and 30.3% reported $150,000 or higher. Thirty-one individuals did not report the race/ethnicity of one or both parents. Of the 104 who did, 83.7% of the children were Caucasian/White, 13.5% multiracial, 1.9% African American, and .9% Asian.

Materials.

Novel word videos. Children viewed videos of two animal hand puppets conversing about aliens (see Table 2 for general dialogue) followed by a picture pointing task with three image options. These brief dialogues were modeled after those used by Yuan and Fisher (2009) and Arunachalam and Waxman (2010) in a syntactic bootstrapping study with 2-year-olds. Videos were on average 16-s long and contained voices from two out of four different individuals. Voice identity was quasirandomly distrib-

[4] Because the museum's staff wished to create an atmosphere of inclusivity, we permitted all interested children to participate in the task. Children were excluded post hoc only for the reasons listed above (out of age range, not monolingual, learning impairment, etc.; i.e. reasons that would have led to them not participating if we had prescreened them for eligibility). We excluded children who had already started the task if they failed to continue the task at that point without making children feel excluded.

Table 2
Study 1 Sentence Frames and General Puppet Video Dialogue

Sentence frame	General script
Is	Puppet 1: I know an alien who is [novel word]. Puppet 2: Really? You know an alien who is [novel word]? Puppet 1: Yes! This alien is [novel word] Puppet 2: Wow! You know an alien who is [novel word]
Feels	Puppet 1: I know an alien who feels [novel word]. Puppet 2: Really? You know an alien who feels [novel word]? Puppet 1: Yes! This alien feels [novel word] Puppet 2: Wow! You know an alien who feels [novel word]
Feels about	Puppet 1: I know an alien who feels [novel word] about brushing his teeth. Puppet 2: Really? You know an alien who feels [novel word] about brushing his teeth.? Puppet 1: Yes! This alien feels [novel word] about brushing his teeth. Puppet 2: Wow! You know an alien who feels [novel word] about brushing his teeth.
Fillers	Puppet 1: I saw an alien who was [novel word]. Puppet 2: Really? You saw an alien who was [novel word]? Puppet 1: Yeah! I saw an alien who was [novel word] Puppet 2: Oh! You saw an alien who was [novel word]

uted across all videos. Conversations about aliens were used both to engage children's interest and to allow the framing of the novel words as new "alien words." This limits any undue influence of already known emotion concept words via mutual exclusivity (i.e., the belief that two words cannot have the same meaning; Clark, 1987; Hutchinson, 1986; Markman, 1990).

Prior to the experiment, each child completed three screening trials. Each screening trial had a single video that discussed an alien engaging in an action (i.e., "I know an alien who likes to eat pizza") and an accompanying descriptive sentence using a verb in the present progressive (i.e., "Point to where the alien is eating pizza!"). To continue, children had to correctly answer at least two trials (i.e., point to the picture of the alien eating pizza and not the distractor pictures), demonstrating that they could watch a brief video accompanied by a verbal description and point to a picture that matched the description.

In the subsequent experimental trials, children watched the hand puppet videos with puppets conversing and introducing a novel word (*binty*, *daxy*, *strupy*, *moky*, *joomy*, *gorpy*, *reksy*, *tropy*) four times using one of the following sentence frames:

Is: The alien is [novel word]

Feels: The alien feels [novel word].

Feels about: The alien feels [novel word] about something.[5]

Each child was presented with the same sentence frame for all experimental trials and no novel word was repeated across trials. Each experimental video and novel word was presented in random order.

In between each experimental trial was a filler trial containing a novel verb in the present progressive (ending in *-ing*: *piffing, tayving, serding*) to indicate an action. The filler trials were included to give children a break from the experimental trials and were not intended as control trials. Nonetheless, child performance on these trials was included as a covariate in the event that children's filler performance significantly impacted their performance on the trials of interest. See online supplemental materials for analyses of filler trials and main analyses without filler trial performance as a covariate. Over the course of the session, each child saw 10 videos (three screening, four experimental, three filler).

Picture pointing task. Following each video, a screen containing auditory instructions with accompanying text instructed the child to "Point to where the alien [sentence frame] [novel word]." The voice from a single individual was used in the auditory instruction. Children then saw three images of a cartoon alien presented in a random array, with each image depicting the alien expressing an emotion, a physical state, or engaging in an action (see Table 3 for list of image types and Figure 1 for sample trial). Children were instructed to point to the image that corresponded to the novel word. Their choice served as the dependent variable. Three alien identities were used in screening trials. Four different alien identities were used for the experimental and filler trials, with the limitation that each experimental trial employed a different alien (thus, the same alien may have been seen in both an experimental trial and a filler, but not in two experimental trials). Images were randomized across all trials to appear once (i.e., children saw all seven possible emotion images appearing in either an experimental or filler trial). All alien stimuli were validated in a separate sample of 3- to 5-year-olds, in which children were better than chance at associating the images with the intended physical state, emotion or action (see online supplemental materials).

Parent questionnaire. While the child completed the computerized task, parents and/or legal guardians completed a voluntary paper questionnaire. Information was gathered on the child's birth, including date, location and whether the mother's pregnancy was normal. Children's general communicative and linguistic development was measured including any information on whether the child had been evaluated for speech problems or learning disabilities, and a rudimentary number of spontaneous word production of a subset of word categories. Information on familial language was gathered, as well as who the child lived with. Parental race/ethnicity, place of birth and native language, education, career, and household income were also gathered. The first was used as a measure of child race/ethnicity.

Procedure. This study was approved by the University of North Carolina Institutional Review Board. Parents of children who looked to be 3–5 years of age were approached at the museum and asked if their child would like to participate in a short video task on word learning. Only children who were 3–5 years of age were subsequently enrolled (with the exception of children who were accidentally enrolled due to a miscommunication about their

[5] For the feels about conditions, story endings were: "about brushing his teeth"; "about cleaning her room"; "about eating cookies"; and "about playing games." The picture pointing task instructed kids to "point to where the alien feels [novel word] about something."

Table 3
Image Stimuli for Study 1 and Study 2

Emotions	happy, excited, sad, mad, scared, disgusted, surprised
Actions	sleeping, jumping, sitting, falling, cartwheeling, walking, running, eating pizza/fruit*, swimming*
Physical states	itchy, hot, cold, sick, burned, hungry, hurt

Note. Four cartoon alien identities exhibited the listed emotion, action, or physical state. Screening trials included an emotion image and two action images.
* denotes action images that were only included in screening trials.

age or allowed to participate because a sibling participated; these children were not included in analyses). Children were told that they would play a game involving aliens. Following the parent/legal guardian's consent, the experimenter spent the first few minutes getting to know the child and obtaining verbal assent. The experimental task was then administered online on a laptop computer via Qualtrics.

Children who failed two or more of the three screening trials were thanked for their time and told that the game was over. If children passed the screening trials, the experimenter then introduced the experimental task by saying "You're doing great! Let's keep playing this game! Now we're going to watch some more videos. These videos are going to have a special alien word and I need help to figure out what that word means! Do you want to play/Are you ready?" If the child wanted to continue, the experimenter then played the first experimental video containing a novel "alien" word followed by a screen with visual and auditory instructions for the picture pointing task. Once an image was chosen, the experimenter confirmed the choice and made the selection by clicking the radio button beneath the image the child chose. If a child was hesitant, the experimenter encouraged them up to three times before continuing to the next trial. Following the video task, children had the option to complete an additional task, not discussed here. For their participation, children received a hand stamp and temporary tattoo.

Results

To examine the impact of sentence frame and age on image choice, mean proportions of each image choice type were created across trial types (e.g., mean proportion of emotion images chosen within each experimental condition).[6] We opted to treat age as a categorical variable rather than a continuous variable due to the ease of interpreting mixed model ANOVAs over regression models with categorical outcomes. We nonetheless also computed multilevel multinomial logistic regression analyses in which age was a continuous predictor and sentence frame was a categorical predictor of choice outcomes (see online supplemental materials). These findings replicated the mixed model ANOVA findings so we report the ANOVA findings in the main text for ease of interpretation.

To examine our main hypothesis that sentence frame and age would interact to influence children's image choice, we conducted a 3 (image choice: emotion, action, physical state) × 3 (sentence frame: is, feels, feels about) × 3 (age: 3, 4, 5) mixed model ANOVA with mean proportions of Image choice as a within subjects factor and sentence frame and age as between subjects factors. To control for the effects of participant gender and screening trial performance, we also conducted a 3 (image choice: emotion, physical state, action) × 3 (sentence frame: is, feels, feels about) × 3 (age: 3, 4, 5) mixed model ANCOVA with gender and performance on the screening trials as covariates. Lastly, to account for filler trial performance, we conducted a 3 (image choice: emotion, physical state, action) × 3 (sentence frame: is, feels, feels about) × 3 (age: 3, 4, 5) mixed model ANCOVA with gender, performance on the screening trials, and performance on filler trials as covariates. Filler trial performance was computed as the proportion of trials in which an action image was chosen. Findings were largely identical across the three analyses, so we report the most conservative ANCOVA findings controlling for gender, performance on screening and filler trials. Findings from the other ANOVA and ANCOVA are available in the online supplemental materials.

See Table 4 for all effects; we explicitly discuss only significant effects and predicted effects. First, we found a main effect of image choice, $F(2, 246) = 3.10$, $p = .05$, $\eta^2 = .03$.[7] Children chose physical state ($p < .001$) and emotion ($p < .001$) images significantly more than action images. Children chose physical state images significantly more than emotion images over all ($p = .002$; see Figure 2).

The main effect of image choice was qualified by a significant interaction between image choice and age, $F(4, 246) = 2.53$, $p = .04$, $\eta^2 = .04$. Simple effects show a significant effect of age on action images, $F(2, 123) = 4.69$, $p = .01$, $\eta^2 = .07$ and a significant effect of age on physical state images, $F(2, 123) = 3.65$, $p = .03$, $\eta^2 = .06$. Pairwise comparisons reveal that 3-year-olds chose action images ($p = .003$) significantly more than 5-year-olds. Five-year-olds chose physical state images ($p = .008$) significantly more than 3-year-olds did. Emotion images were chosen equally between all ages (see Figure 3).

As predicted, there was a marginal interaction between image choice and sentence frame, $F(4, 246) = 2.28$, $p = .06$, $\eta^2 = .04$, suggesting that children relied on more restrictive sentence frames to inform image choice. Simple effects reveal that the proportion of trials in which emotion images were chosen is marginally influenced by the sentence frame, $F(2, 123) = 2.92$, $p = .06$, $\eta^2 = .05$. Pairwise comparisons demonstrated that emotion images were chosen significantly more in the feels about ($p = .02$) than the feels condition, but that the is condition ($p = .57$) did not differ from feels about condition. Emotion images were chosen marginally more during is trials than during feels trials ($p = .09$; see Figure 4).

We did not find a predicted three-way interaction between image choice, age, and sentence frame, suggesting that children did not rely more on sentence frame with increasing age. Instead, age and sentence frame separately moderated image choice.

[6] Eight children had technical difficulties during one or two trials. In these cases, mean proportions were weighted by the number of completed trials.

[7] Mauchly's test indicated that the assumption of sphericity was violated, $\chi^2(2) = 6.36$, $p = .04$, therefore degrees of freedom were corrected using Huynh-Feldt corrections follow Girden (1992) suggestion based on Greenhouse-Geisser estimate, $\varepsilon = 0.95$, being greater than .75.

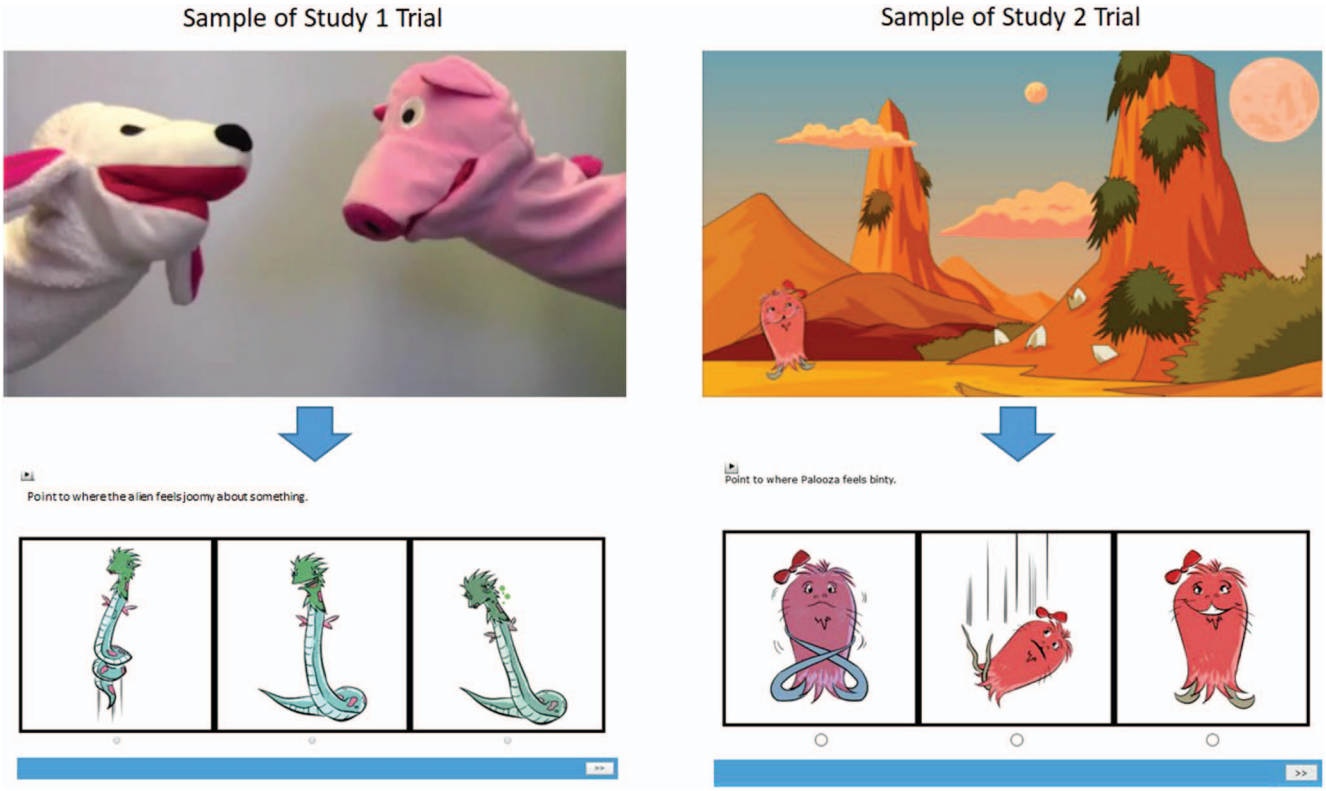

Figure 1. Sample trials for Study 1 and Study 2. For the text of the Study 1 video, see Table 2. In Study 2, children heard a two to three sentence story, see Table 4 for examples. Each video was played on a screen by itself, and the next screen presented three randomized images of the alien character, accompanied by audio instructions for the child to point to the image they believe depicts the novel word. See the online article for the color version of this figure.

Discussion

Results provide preliminary support for our hypotheses in Study 1, which is a conservative test of the syntactic bootstrapping hypothesis in which children received no other context for the meaning of a novel word except the sentence frame it was heard in. We found that age influenced children's tendency to perceive a novel word as denoting an internal state (physical state or emotion) over an action. Three-, 4-, and 5-year-olds were equally likely to choose emotion images, with the relative proportion of physical state to action choices increasing over age. Three-year-olds chose more action items than 5-year-olds, whereas 5-year-olds were more likely than 3-year-olds to choose physical state images. Because all of our novel words ended in *-y* (*daxy*, *joomy*, *binty*), and words ending in this sound are prototypically adjectives (*happy*, *bouncy*, *hungry*, *thirsty*, *rosy*, *furry*, *smelly*), this feature alone may have been a cue to 5-year-old children that novel words labeled attributes or states. The fact that 3-year-olds chose the action images the most out of the age groups suggests that 3-year-olds may not yet understand that words ending in *-y* are likely to be adjectives.

We also found suggestive evidence that more restrictive sentence frames impact children's understanding that novel words refer to emotions, although this effect was only marginal. Children were more likely to choose emotions in the most restrictive sentence frame (feels about) as compared with the feels condition. Children were equally likely to choose emotions in is and feels about conditions, but recall that *is [emotion adjective]* is also a grammatically correct choice.

Table 4
Study 1 Within Subjects Main Effects and Interactions for 3 (Image Choice: Emotion, State, Action) × 3 (Sentence Frame: Is, Feels, Feels About) × 3 (Age: 3, 4, 5) Mixed Model ANCOVA With Participant Gender, Screening Trial Performance, and Filler Trial Performance as Covariates

Variable	*df*	*F*	$/^2$	*p*
Image choice	2	3.10	.03	.05
Image Choice × Screening Trial Performance	2	4.23	.03	.02
Image Choice × Gender	2	2.65	.02	.07
Image Choice × Filler Performance	2	3.55	.03	.03
Image Choice × Age	4	2.53	.04	.04
Image Choice × Sentence Frame	4	2.28	.04	.06
Image Choice × Age × Sentence Frame	8	1.28	.04	.25

Note. Mauchly's test indicated that the assumption of sphericity was violated, l^2 (2) = 6.36, p = .04, therefore degrees of freedom were corrected using Huynh-Feldt corrections follow Girden (1992) suggestion based on Greenhouse-Geisser estimate, $\sum$ = .95, being greater than .75, df_{error} = 246.

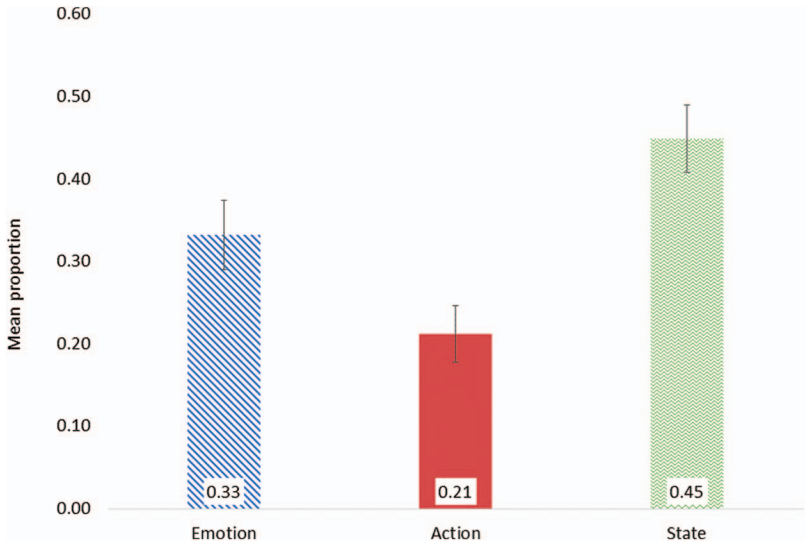

Figure 2. Study 1 estimated marginal means of each image choice. Bars represent 95% confidence intervals. See the online article for the color version of this figure.

We note that we did not find the predicted three-way interaction between age, sentence frame, and image choice. This null finding could in part be a result of the conservative study design we used, in which children received no other context but the linguistic context. If younger children cannot use sentence frames effectively and thus choose randomly, whereas older children are reasonably concluding that is, feels, and feels about are each grammatically appropriate for a third of the trials, then it may have been difficult to observe a three-way interaction. This interaction was perhaps even more difficult to observe in light of all children's bias toward choosing physical state images.

There are two potential interpretations of children's bias toward physical state images. First, a bias toward choosing the physical state (as opposed to the emotion) may merely reflect the relative salience of these images to children, as physical state images in our study often contained other potentially interesting details such as areas of differently colored skin, bandages, and so forth, which were necessary to convey meanings such as *cold, hot, hurt,* and *sick.* This bias might have especially occurred in Study 1 because there was no other situational information to drive children's attention to the other images. Without situational information, the older children may have used the linguistic cue of the novel word ending in *-y* (suggestive of an adjective, rather than the verb-indicating *-ing*) to narrow their choices down to the physical state and emotion images, and then fixated on the physical state images due to their additional intrigue. Indeed a few children did note that they chose images based on color (i.e., "that one because it's blue" and "I chose that one cause it's blue and blue is my favorite color").

This interpretation is consistent with the fact that children even showed a bias toward physical state images in the filler condition (see online supplemental materials). We included filler items because it is common to include filler items to break up the experimental trials on this type of task (Gerken & Shady, 1996). Note that accounting for children's performance on the filler trials did not alter our results, meaning that children's ability to perform on

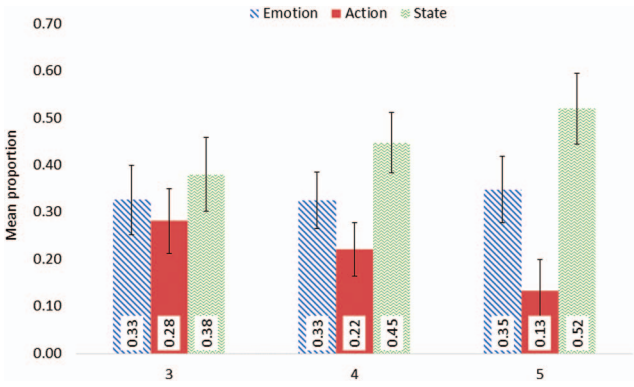

Figure 3. Study 1 estimated marginal means of each image choice by age in years. Bars represent 95% confidence intervals. See the online article for the color version of this figure.

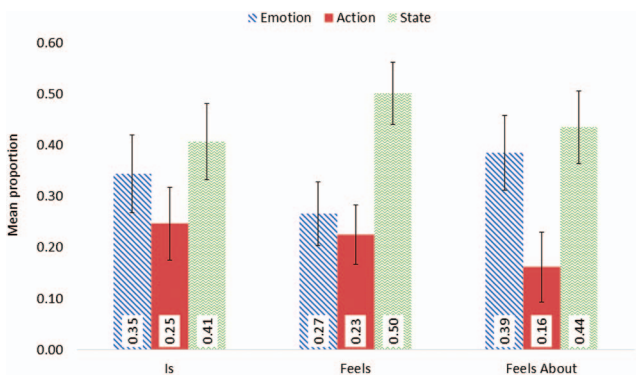

Figure 4. Study 1 estimated marginal means of each image choice by sentence frame. Bars represent 95% confidence intervals. See the online article for the color version of this figure.

filler trials did not affect our findings. Nonetheless, we cannot be sure why children chose the physical state images on the filler trials. One possibility is that in the absence of any situational context, children inferred that the images had multiple meanings. That is, an image of a physical state in which an alien was sick could have been interpreted as also "disgusted" or "sad" by children, which would have been technically correct. Our validation data are somewhat consistent with this interpretation; although children performed greater than chance on all stimuli, the stimuli that they performed the least accurately on were the physical states of "sick" and "hurt." In both cases, children were most likely to misinterpret these states as emotional (e.g., disgusted, sad). This fact is not likely to just be a limitation of our stimuli. Mental states have multiple levels of meaning and individuals differ in the complexity of the inferences drawn about those states—a person who has tears coming from their eyes and is emitting sound from their mouth could be "crying," "sad," or "experiencing grief at a loss" (Vallacher & Wegner, 1987, 1989; Wegner & Vallacher, 1987). Even highly caricatured facial expressions of emotion are perceived as indicative of mental states in some cultures (e.g., sad) but as actions (e.g., crying) in others (Gendron, Roberson, van der Vyver, & Barrett, 2014).

Nonetheless, observations of children's spontaneous comments, in combination with our validation data, suggests that on average children understood the intended meaning of the alien images. Children were more accurate than chance at identifying the correct emotion, physical state, and action image in our validation study (see online supplemental materials). Additionally, children's spontaneous utterances during our experimental trials suggested that they understood the meaning of the stimuli. For instance, for action images children stated "this is running," "[s/he is] falling down," "the one who is walking is moky," or imitated running. For physical state images children proclaimed things such as "this one's hot," "sweaty!," "he has two Band Aids, he hurts," "maybe he broke his leg," and "he's ouchy." Finally, for emotion images children made statements such as "this means mad," "he's scared!," and "that one is sad."

Second, it is possible that children had a bias toward the physical state images because the feels versus feels about sentence frame was not sufficiently helpful across the age range to help children move beyond their bias toward physical state images. This interpretation is consistent with our observation of an interaction between image choice and sentence frame, but lack of a three-way interaction between sentence frame, age, and image choice. The marginal interaction between image choice and sentence frame suggests that children may be able to use the sentence frame to begin to home in on the correct word meaning, supporting prior research (Becker, 2015; Gleitman et al., 2005; Papafragou et al., 2007). However, the fact that older children were not significantly more likely to choose the emotion image over physical state images in the feels about condition suggests that even 4- and 5-year-olds are not yet able to use feels about to restrict an adjective meaning to an emotion rather than a physical state.

Taken together, the findings of Study 1 suggest that although linguistic cues may be meaningful to children in this age range, children may not be able to use sentence-level cues alone to understand emotion adjectives. These findings are consistent with recent work showing that the same sentence-level cues children are known to exploit for learning verbs may not be usable for adjectives at this stage of development (Booth & Waxman, 2009; Syrett, Latourrette, Ferguson, & Waxman, 2018). However, as we note, Study 1 is a particularly conservative test of the syntactic bootstrapping hypothesis, as it is atypical for children to experience emotion concepts and their words in the absence of an emotional situation. We thus included situational context in Study 2 to more clearly test the role of sentence frame in children's understanding of novel emotion words when an emotional situation was also present.

Study 2

Because research on emotion concept development demonstrates that children rely on situational context—including the causes and consequences of an emotion when determining the meaning of an emotional facial expression (Kayyal et al., 2015; Widen & Russell, 2010, 2011)—we modified Study 1 to include information about the situational context a novel adjective was occurring in. Study 1 was a conservative test of the syntactic bootstrapping hypothesis, but we reasoned that including situational context would ultimately be a more ecologically valid test of the types of contexts in which children learn about emotions (e.g., when observing an event and hearing an adult talk about it).

To achieve this end, children in Study 2 viewed videos of a cartoon alien experiencing emotional situations. We predicted that with this additional situational context present, we would observe a three-way interaction such that older children would be more likely to choose emotion images when the sentence frame was maximally restrictive. As the procedure is largely identical to Study 1, we only describe the differences between them below.

Method

Participants. One hundred forty-seven children participated in the study at the Museum of Life and Science in Durham, North Carolina. As in Study 1 children who did not meet our a priori inclusion criteria were excluded from further analysis. Nine were not within our desired age range (had mistakenly been enrolled or allowed to participate because a sibling had done so). Seven were removed from analysis because they lived in households where languages other than English were spoken greater than 50% of the time, and one was later found to have a learning disability as reported by their parent/legal guardian in the parent questionnaires. Eighteen children did not complete the video task either due to screening trials failure ($n = 9$) or opting not to continue in the midst of the task ($n = 9$). The final sample consisted of 113 ($M_{age} = 4.04$, $SD_{age} = .77$; 45 females) children: 31 3-year-olds (eight female), 46 4-year-olds (26 female), and 36 5-year-olds (11 female).

Parents and/or legal guardians completed a voluntary packet of questionnaires identical to that in Study 1. Twelve individuals did not report family income; of the 101 who did, 20.8% reported a household income <$70,000; 28.7% between $70,000 and $100,000; 26.7% between $100,000 and $150,000; and 23.8% reported $150,000 or higher. Sixteen parents/guardians did not fill out the race/ethnicity information for one or both parents. Of the 97 who did, 82.5% of the children were Caucasian/White, 14.4%

Table 5
Sample Stories for Each Emotion Type of Study 2 and Novel Words

Emotion	Story
Happy	Palooza ran a race at school. She was the fastest alien in the race, so she won first place! Now, Palooza [sentence frame] [novel word]. What do you think [novel word] means?
Sad	Xylobean's best friend moved away to a different planet, and they won't see each other again. Now, Xylobean [sentence frame] [novel word]. What do you think [novel word] means?
Mad	Chromia was reading her favorite book. Then, another alien took it and tore out a page! Now, Chromia [sentence frame] [novel word]. What do you think [novel word] means?
Surprised	One day Wazu came home and all his furniture was turned upside-down. He just stared at his furniture and couldn't figure out how that happened. Now, Wazu [sentence frame] [novel word]. What do you think [novel word] means?
Disgusted	Palooza took a bite of an apple. As soon as she bit into it, she realized it was rotten inside. She didn't want to eat the rest of it. She threw it in the trash. Now, Palooza [sentence frame] [novel word]. What do you think [novel word] means?
Afraid	Wazu heard a loud crashing noise in the distance. Then, the sound started getting closer and closer! Now, Wazu [sentence frame] [novel word]. What do you think [novel word] means?
Excited	Chromia always wanted to fly in a spaceship. Now she was going to get a chance to do it! Now, Chromia [sentence frame] [novel word]. What do you think [novel word] means?

multiracial, 1.03% African American, 1.03% Asian, and 1.03% Hispanic.

Materials.

Novel word videos. Children viewed videos of an alien cartoon character with a narrator describing a short story (see Table 5 for sample stories). Videos were created using GoAnimate (http://www.goanimate.com) and were on average 23.85 s. A single individual narrated the story for all videos. The screening video scripts were similar to Study 1, but now had a single narrator, a name associated with the alien, and a cartoon accompanying the auditory stimuli. Children who failed two or more of the three screening trials were thanked for their time and told that the game was over.

During the experimental trials, children watched seven cartoon videos with accompanying narration: Each video employed a different novel word (*daxy*, *moky*, *reksy*, *binty*, *gorpy*, *joomy*, *tropy*) in one of three between-subjects experimental sentence frames (is, feels, feels about) as in Study 1. Each alien character in the video had a neutral expression. Aliens, video stories, and novel words were fully randomized such that no single alien, story, or word were consistently paired together. In contrast to Study 1, the novel word was presented twice (rather than four times) in the video and a third time (rather than fifth time) in the picture pointing task instructions (see Table 5 for sample stories and Figure 1 for a sample trial). Emotional situations were created by providing a brief story that highlighted a positive or negative discrete emotional experience for the alien (the alien was *happy, sad, afraid, mad, excited, disgusted,* or *surprised*), prior to the introduction of the novel word in the target sentence frame. Stories were kept short to limit cognitive burden and to keep the child's attention. Stories were developed based on prior work (see Widen & Russell, 2010) drawing from the prototypical causes of emotions in a North American setting. A total of seven experimental trials of a single alien identity were presented. We reasoned that variation across videos (i.e., seeing aliens and stories) would be sufficiently attention-capturing for children so we did not include filler trials to maintain their attention. All sessions began with the *happy* story followed by the remaining six emotions in randomized order. We modeled this method after other developmental research on emotion (Russell & Widen, 2002a, 2002b; Widen & Russell, 2010). In these studies, *happy* trials are presented first because *happiness* is a well-understood emotion concept for 3- to 5-year-olds; it is assumed that receiving a more difficult emotion concept first might discourage children.

Picture pointing task. Cartoon alien images were identical to Study 1 (see Table 3), however, each matched the alien seen in the video, where s/he was given an identifying name (screening trials: Chrysanthemum, Magenta, Frebedo; experimental trials: Palooza, Chromia, Wazu, Xylobean). Female participants viewed either Palooza or Chromia (the "female" aliens) and male participants viewed either Wazu or Xylobean (the "male" aliens). We matched the gender of the aliens and children because there is some evidence that interpersonal similarity facilitates mental state inference (Ames, 2004). All children saw Chrysanthemum, Magenta, and Frebedo for the screening trials. During the picture pointing task, images of the aliens displaying a particular emotion, action, and physical state image appeared only once throughout the seven trials such that no image was repeated (e.g., children saw a happy alien on only one trial throughout the experiment). The emotional image depicted always matched the story (e.g., children saw a happy alien for a story describing *happiness*) but the particular action and physical state seen were randomly displayed.

Procedure. This study was approved by the University of North Carolina Institutional Review Board. The procedure was identical to Study 1, save that participants saw videos of the alien scenarios, rather than videos of puppets holding short conversations.

Results

Analysis procedures are identical to that in Study 1 with mean proportions of each image choice type calculated across trial types (e.g., mean proportion of emotion images chosen within each experimental condition)[8] entered in mixed model ANOVAs. To examine our main hypothesis, a 3 (image choice: emotion, physical state, action) × 3 (sentence frame: is, feels, feels about) × 3 (age: 3, 4, 5) mixed model ANOVA was conducted with image choice as a within subjects factor and sentence frame and age as between subjects factors. As in Study 1, we also computed a 3 (image choice: emotion, physical state, action) × 3 (sentence

[8] One child experienced technical difficulties during one trial. As in Study 1, their mean proportions were adjusted to be out of the number of completed trials.

frame: is, feels, feels about) × 3 (age: 3, 4, 5) mixed model ANCOVA with Image choice as a within subjects factor and sentence frame and age as between subjects factors, including participant gender and performance on the screening trials as covariates. Findings were largely identical across the two analyses so we report the more conservative ANCOVA findings. See online supplemental materials for the ANOVA and multilevel multinomial logistic regression analyses.

See Table 6 for all effects; we discuss only the significant effects and predicted effects here. As predicted, and as in Study 1, we found a significant interaction between image choice and age, $F(3.73, 190.38) = 8.29$, $p < .001$, $\eta^2 = .14$.[9] Emotion images were chosen more as age increases, and both physical state and action images were chosen less as age increases. Simple effects reveal significant age differences in the proportion of trials in which emotion images were chosen, $F(2, 102) = 12.63$, $p < .001$, $\eta^2 = .20$, action images were chosen, $F(2, 102) = 5.65$, $p = .005$, $\eta^2 = .10$, and physical state images are chosen, $F(2, 102) = 4.59$, $p = .01$, $\eta^2 = .08$. Pairwise comparisons reveal that 5-year-olds chose emotion images significantly more than 4- ($p = .01$) and 3-year-olds ($p < .001$). Four-year-olds chose emotion images significantly more than 3-year-olds ($p = .006$). Three-year-olds chose action images significantly more than 4- ($p = .03$) and 5-year-olds ($p = .001$). Four- and 5-year-olds did not differ significantly in the proportion of action images chosen ($p = .18$). Three-year-olds chose physical state images significantly more than 5-year-olds ($p = .003$). Three- and 4-year-olds did not differ in significantly in the proportion of trials in which they chose physical state images ($p = .12$; see Figure 5).

Critically, as predicted, we found a three-way interaction between image choice, age, and sentence frame, $F(7.47, 190.38) = 2.49$, $p = .02$, $\eta^2 = .09$ (see Figure 5). To further probe this interaction, we examined the two-way interaction between sentence frame and image choice for each age-group. There was no interaction between sentence frame and image choice for 3-year-olds, $F(4, 52) = .41$, $p = .80$, $\eta^2 = .03$, suggesting that 3-year-olds were unable to use the sentence frame to guide their choice of images.

Table 6
Study 2 Main Effects and Interactions for 3 (Image Choice: Emotion, State, Action) × 3 (Sentence Frame: Is, Feels, Feels About) × 3 (Age: 3, 4, 5) Mixed Model ANCOVA Including Participant Gender and Screening Trial Performance as Covariates

Variable	*df*	*F*	l^2	*p*
Image choice	1.87	1.71	.02	.19
Image Choice × Screening Trial Performance	1.87	3.92	.04	.03
Image Choice × Gender	1.87	.44	.004	.63
Image Choice × Age	3.73	8.29	.14	.001
Image Choice × Sentence Frame	3.73	1.30	.03	.27
Image Choice × Age × Sentence Frame	7.47	2.49	.09	.02

Note. Mauchly's test indicated that the assumption of sphericity was violated, l^2 (2) = 21.81, $p < .001$, therefore degrees of freedom were corrected using Huynh-Feldt corrections follow Girden (1992) suggestion based on Greenhouse-Geisser estimate, ∑ = .837, being greater than .75, $df_{error} = 190.38$.

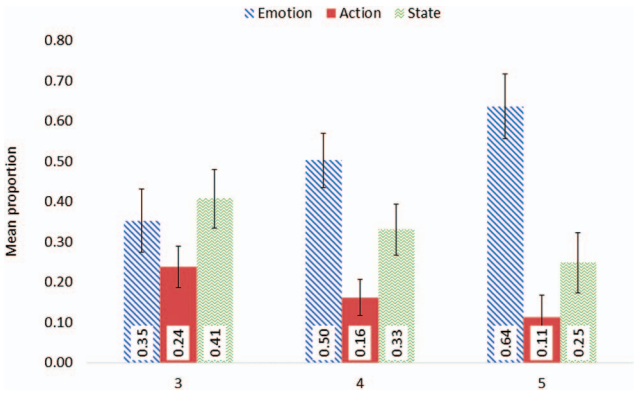

Figure 5. Study 2 estimated marginal means of each image choice by age in years. Bars represent 95% confidence intervals. See the online article for the color version of this figure.

However, as predicted, there was a significant interaction between sentence frame and image choice for 4-year-olds, $F(3.80, 77.99) = 2.67$, $p = .04$, $\eta^2 = .12$.[10] Examination of the simple effects for 4-year-olds reveals that emotion images were selected to a different degree based on sentence frame, $F(2, 41) = 3.37$, $p = .04$, $\eta^2 = .14$. Pairwise comparisons reveal that 4-year-olds chose emotion images significantly less in the is frame than the feels frame ($p = .01$), but did not differ between the is and feels about frame ($p = .13$). Emotion images did not differ between feels and feels about ($p = .17$). Four-year-olds thus chose emotion images similarly across feels and feels about sentence frames and least in is sentence frames. Simple effects also revealed that 4-year-olds chose action images to a different degree based on sentence frame, $F(2, 41) = 3.90$, $p = .03$, $\eta^2 = .16$. Pairwise comparisons demonstrated that 4-year-olds chose action images significantly more in is frames than feels frames ($p = .01$) and feels about frames ($p = .02$). Sentence frame did not influence the proportion of trials in which physical state images were chosen, $F(2, 41) = 1.00$, $p = .38$, $\eta^2 = .05$ (see Figure 6). Finally, the interaction between image choice and sentence frame for 5-year-olds was not significant, $F(2.79, 43.24) = 2.14$, $p = .11$, $\eta^2 = .12$[11] (see Figure 6).

Discussion

Study 2 revealed that when children could draw on a situational context that highlighted a caused emotion, age interacted with sentence frame to alter image choice. When the situational context

[9] Mauchly's test indicated that the assumption of sphericity was violated, $\chi^2(2) = 21.81$, $p < .001$, therefore degrees of freedom were corrected using Huynh-Feldt corrections follow Girden (1992) suggestion based on Greenhouse-Geisser estimate, $\varepsilon = 0.837$, being greater than .75, $df_{error} = 190.38$.

[10] Mauchly's test indicated that the assumption of sphericity was violated, $\chi^2(2) = 8.81$, $p = .012$, therefore degrees of freedom were corrected using Huynh-Feldt corrections follow Girden (1992) suggestion based on Greenhouse-Geisser estimate, $\varepsilon = 0.84$, being greater than .75.

[11] Mauchly's test indicated that the assumption of sphericity was violated, $\chi^2(2) = 17.06$, $p < .001$, therefore degrees of freedom were corrected using Greenhouse-Geisser corrections follow Girden (1992) suggestion based on Greenhouse-Geisser estimate, $\varepsilon = 0.70$, being less than .75.

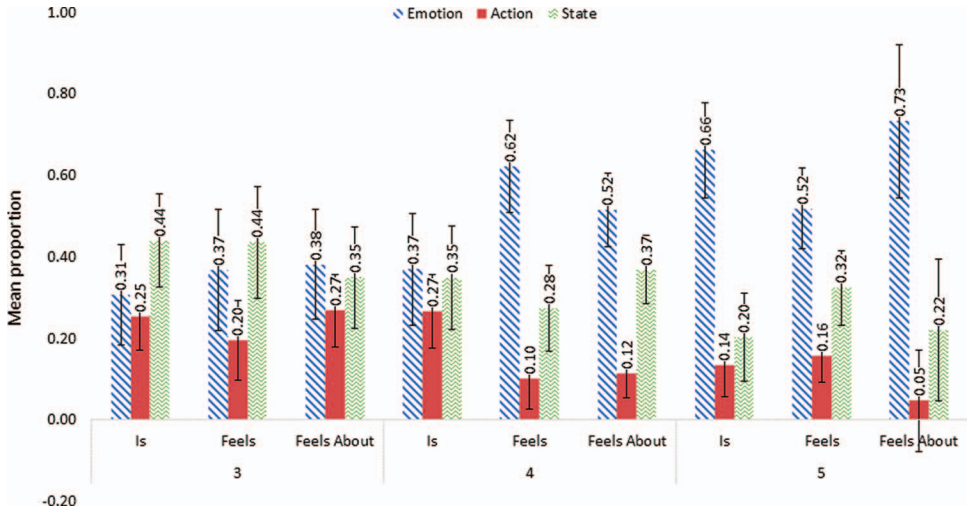

Figure 6. Study 2 3-way interaction between image choice, age in years, and sentence frame. Bars represent 95% confidence intervals. See the online article for the color version of this figure.

suggested that a novel word referred to an emotion concept, the sentence frame particularly influenced image choices for 4-year-olds. Three-year-olds were unable to use the sentence frame to help guide their image choices and chose randomly. Five-year-olds chose the emotion most frequently regardless of sentence frame. Five-year-olds thus recognized that feels about is a sentence frame that is compatible only with emotion meanings, but that emotion meanings were otherwise appropriate in all conditions (due to both the story contexts and linguistic framing). However, 4-year-olds were more likely to choose emotion images in the feels and feels about conditions than in the Is condition, suggesting that they were using sentence frame in combination with the situational context to understand that a novel word labeled an emotion.

Interestingly, our findings suggest that more restrictive sentence frames are not useful for children of all ages. Four-year-olds chose emotion images more in the feels condition than the feels about condition, whereas 5-year-olds chose emotion images less in the feels condition than in both the is and feels about conditions. Together, these findings suggest that feels about may not be a useful cue for 3- and 4-year-olds, for whom feeling an abstract state that is in response to an unknown cause might be too complicated of a mental state inference. In contrast, 5-year-olds used feels about easily and show similar facility doing so with is, which is a much less complex (and less restrictive) sentence frame. It is unclear why 5-year-olds did not choose emotions as frequently in the feels condition as in the feels about and is conditions, but this finding may be related to the fact that 5-year-olds are beginning to use more complex sentence frames, such as feels about for emotional states. Although these questions should be addressed in future research, Study 2 presents initial evidence that children are using the sentence frame to understand the meaning of novel emotion words when those words are heard in the context of an emotional situation.

General Discussion

Across two studies, we examined the extent to which both linguistic and situational cues are important in children's understanding that novel words denote emotion concepts, as opposed to physical state or action concepts. Study 1 provided preliminary evidence that, consistent with the linguistic literature on verb learning, sentence frames may be informative for children about the meaning of novel emotion concept words. A marginal interaction between image choice and sentence frame suggests that children may be able to use more restrictive sentence frames to home in on a word's meaning. However, these data suggest that sentence frame alone may not be sufficient for children to understand that a novel word denotes an emotion concept. Study 2 further examined the role of sentence frames when children had access to situational cues, mirroring more ecologically valid learning contexts. When linguistic input was heard in the presence of situational cues, we observed a predicted three-way interaction between image choice, age, and sentence frame. Sentence frame guided the selection of emotion images over physical state or action images for 4-year-olds, but not 3-year-olds. This finding is interesting insofar as even 2-year-olds can exploit sentence frames for learning verb meanings (Arunachalam & Waxman, 2010; Yuan & Fisher, 2009). However, adjectives are more difficult to learn than verbs, and other evidence shows that 3-year-olds have difficulty using sentence frames to draw inferences about the meaning of adjectives (Syrett et al., 2018). Mental state categories such as emotions and physical states may be even more difficult to map onto lexical items than physical characteristics. In contrast to 3- and 4-year-olds, 5-year-olds appeared to rely more heavily on the situational context and realized that all sentence frames were grammatically consistent with an emotion interpretation.

One explanation of our findings is that they are separately driven by the development of emotional understanding and syntactic bootstrapping. That is, these processes could be truly interacting as separate phenomena. If this is true, children develop the ability to represent discrete emotion concepts alongside the separate ability to use syntactic bootstrapping to infer meanings of novel predicate words. Another possibility is that both of these abilities—the representation of emotion concepts and the acquisition of emotion words—are constrained by the more general

ability to make mental state inferences. Without the ability to draw mental state inferences, 3-year-olds are unlikely to correctly understand what type of mental state the alien in the story is experiencing. By the same token, without the ability to draw more complex mental state inferences about others' communicated intentions, 3-year-olds may be unable to use sentence frame information to map a novel word onto a particular mental state meaning. Although research suggests that emotion understanding and mental state inferences such as beliefs may follow a similar developmental trajectory (Bretherton & Beeghly, 1982; Cutting & Dunn, 1999; Dunn, Brown, Slomkowski, Tesla, & Youngblade, 1991; Harris et al., 1989; Weimer, Sallquist, & Bolnick, 2012), more research should examine the simultaneous development of mental state inference, emotional understanding, and syntactic bootstrapping and the extent to which they rely on similar versus distinct cognitive processes.

Limitations and Future Directions

Given that these are the first studies to our knowledge to examine how children learn novel emotion word meanings, they are not without limitations. One limitation was that we used sentence frames that may not reflect those used most frequently in daily life. In daily life, emotion words are presented to children in a number of different sentence frames by parents, teachers, and peers. It is possible that within our targeted age range, children are not exposed to emotion words within *is, feels*, or *feels about* sentence frames with equal frequency. Thus, it is important to examine corpora of child-directed speech to empirically examine the most frequent linguistic input and output used when adults and children are discussing emotions (see Shablack, Stein, Lindquist & Becker, 2019). These data-driven findings might then be used in future research to examine the variety of sentence frames used by children and their parents to talk about emotion concepts in daily life.

Another limitation of our study concerns the sample used in the present studies. In both Study 1 and Study 2, a large portion of the participants are from high socioeconomic households. Evidence suggests that socioeconomic status is influential on learning and developmental trajectories in general (Bradley & Corwyn, 2002; Hoff, 2003). The sample and findings should thus be extended to other populations, where both emotional and linguistic development might be more variable. Additionally, based on conversations with parents/legal guardians following the study, some children were involved in school programs focusing on emotion development and understanding, which may have improved their performance in our task, overall.

Another limitation of our study was the stimuli we used. We focused on alien stimuli in the present experiments for several reasons. First, we were concerned that using human stimuli might cause children to infer that a new word could not name a human emotion concept that they already knew a word for (e.g., *binty* could not refer to the human concept *happiness* because most children know that the word *happy* names this concept by ages 3–5). Additionally, we reasoned that alien stimuli would be maximally entertaining and engaging to children in our sample. However, as we noted in Study 1, children could have had problems understanding the intended meaning of the cartoons. Our validation study, children's spontaneous verbal expressions in Study 1 and choice behavior in Study 2, suggests that this possibility is of limited concern. Yet a broader concern is that cartoons of aliens depicting emotional expressions are not ecologically valid and thus limit the inferences that can be drawn about how children learn about the words that correspond to real human emotional expressions. This being said, the ecological validity of the posed, caricatured human facial expressions used in most psychology experiments is also questionable (Nelson & Russell, 2011; Quigley, Lindquist, & Barrett, 2013). One interpretation of these posed facial expressions is that they are more like symbols than veridical representations of what people do with their faces in daily life (Adams, Albohn, & Kveraga, 2016; Gendron, Mesquita, & Barrett, 2013; Jack, Garrod, Yu, Caldara, & Schyns, 2012). Thus, there may be greater parallels between our studies and studies using human facial stimuli than appears at first glance. Nonetheless, in future research, it is important to replicate and extend our findings with ecologically valid images of human emotional facial expressions, actions and physical states.

In addition to these future directions, future research might consider existing individual differences that influence the learning of novel emotion concept words. For example, as emotion development is correlated with linguistic and verbal ability, future studies might gather validated performance-based measures of children's language ability, such as the MacArthur Communicative Development Inventory score (Fenson et al., 2007) or Peabody Picture Vocabulary Test (Dunn & Dunn, 2007), rather than parent report. It would also be interesting to know whether individuals who know multiple languages, who may be more sensitive to different sentence frames and more adept at disambiguating the meaning of novel words across multiple languages, differ in their abilities to infer that novel words refer to emotions. To the extent that positive rearing environments confer more opportunities for caregiver discourse about emotion, it would also be interesting to explore the extent to which adversity predicts different outcomes in parents' linguistic framing of emotion and the impact on later outcomes in emotional understanding.

Implications

Although this line of work is new, it has important implications for the role of language in children's emotion understanding, communication, and in their ability to perceive emotions in others or experience them firsthand (Lindquist, 2017; Lindquist et al., 2016; Lindquist, MacCormack, et al., 2015; Lindquist, Satpute, et al., 2015). Above all, this work sheds new light on how children are learning about social categories and using them to make meaning of the world around them. Like the research before it, our findings suggest that drawing inferences about emotion concepts may be a gradual process that occurs over the course of early childhood and relies on both the use of language (Widen, 2013; Widen & Russell, 2008), caregiver communication (Cutting & Dunn, 1999; Dunn, Brown, & Beardsall, 1991; Dunn, Brown, Slomkowski, et al., 1991), and an understanding of the situational context (Widen & Russell, 2010, 2011).

Our work thus has important implications for how caregivers and parents can use both language and the present situation to aid children in understanding adjectives, including abstract adjectives such as emotion words. Increasing emotion understanding through language is an important part of development as it can lead to better social outcomes, such as successful communication about

one's own and others' emotional states, in turn leading to better interpersonal relationships, classroom environments, work environments and leadership (Brackett et al., 2013; Hagelskamp et al., 2013; Rivers, Brackett, Reyes, Elbertson, & Salovey, 2013), less risky behavior (Rivers, Brackett, Omori, et al., 2013), improved grades (Brackett, Rivers, Reyes, & Salovey, 2012), less social isolation (Twenge et al., 2003), and more prosocial behavior (Eggum et al., 2011). Understanding a larger range of emotion concepts is associated with greater emotion differentiation, which is also associated with many positive social outcomes such as lower levels of stress, better emotion regulatory strategies, and overall positive well-being (Kashdan et al., 2015; Lindquist & Barrett, 2008). This work can also be applied to curricula aimed at enhancing children's learning of emotion concepts (e.g., Nathanson, Rivers, Flynn, & Brackett, 2016; Rivers, Tominey, O'Bryon, & Brackett, 2013; Weimer et al., 2012). We look forward to future work examining how children learn about emotions via language, and interventions that aim to harness this phenomenon to increase emotion understanding.

Context

Lindquist and Shablack study the role of language in emotion perception and experiences across the life span and Becker examines the acquisition of predicates and word meanings in children. Upon meeting at a university panel, we realized how little research explores how children acquire emotion words in the first place. Thus, we combined our interdisciplinary expertise in emotion and linguistic development.

References

Adams, R. B. J., Albohn, D. N., & Kveraga, K. (2016). A social vision account in facial expression perception. In J. A. Russell & J. M. Fernandez-Dols (Eds.), *The science of facial expression* (pp. 315–332). New York, NY: Oxford.

Ames, D. R. (2004). Inside the mind reader's tool kit: Projection and stereotyping in mental state inference. *Journal of Personality and Social Psychology, 87,* 340–353. http://dx.doi.org/10.1037/0022-3514.87.3.340

Arunachalam, S., & Waxman, S. R. (2010). Meaning from syntax: Evidence from 2-year-olds. *Cognition, 114,* 442–446. http://dx.doi.org/10.1016/j.cognition.2009.10.015

Astington, J. W., & Jenkins, J. M. (1999). A longitudinal study of the relation between language and theory-of-mind development. *Developmental Psychology, 35,* 1311–1320. http://dx.doi.org/10.1037/0012-1649.35.5.1311

Baron-Cohen, S. (1991). Do people with autism understand what causes emotion? *Child Development, 62,* 385–395. http://dx.doi.org/10.2307/1131011

Baron-Cohen, S., & Wheelwright, S. (2004). The empathy quotient: An investigation of adults with Asperger syndrome or high functioning autism, and normal sex differences. *Journal of Autism and Developmental Disorders, 34,* 163–175. http://dx.doi.org/10.1023/B:JADD.0000022607.19833.00

Barrett, L. F. (2006). Solving the emotion paradox: Categorization and the experience of emotion. *Personality and Social Psychology Review, 10,* 20–46. http://dx.doi.org/10.1207/s15327957pspr1001_2

Barrett, L. F. (2013). Psychological construction: The Darwinian approach to the science of emotion. *Emotion Review, 5,* 379–389. http://dx.doi.org/10.1177/1754073913489753

Barrett, L. F., & Russell, J. A. (Eds.). (2015). An introduction to psychological construction. *The psychological construction of emotion* (pp. 1–17). New York, NY: Guilford Press.

Bates, E., Marchman, V., Thal, D., Fenson, L., Dale, P., Reznick, J. S., . . . Hartung, J. (1994). Developmental and stylistic variation in the composition of early vocabulary. *Journal of Child Language, 21,* 85–123. http://dx.doi.org/10.1017/S0305000900008680

Becker, M. (2006). There began to be a learnability puzzle. *Linguistic Inquiry, 37,* 441–456. http://dx.doi.org/10.1162/ling.2006.37.3.441

Becker, M. (2014). *The acquisition of syntactic structure: Animacy and thematic alignment*. Cambridge, UK: Cambridge University Press. http://dx.doi.org/10.1017/CBO9781139022033

Becker, M. (2015). Animacy and the acquisition of tough adjectives. *Language Acquisition, 22,* 68–103. http://dx.doi.org/10.1080/10489223.2014.928298

Becker, M., & Estigarribia, B. (2013). Harder words: How children learn abstract verbs with opaque syntax. *Language Learning and Development, 9,* 211–244. http://dx.doi.org/10.1080/15475441.2013.753798

Berenbaum, H., & Oltmanns, T. F. (1992). Emotional experience and expression in schizophrenia and depression. *Journal of Abnormal Psychology, 101,* 37–44. http://dx.doi.org/10.1037/0021-843X.101.1.37

Bloom, P. (2000). *How do children learn the meanings of words*. Cambridge, MA: MIT press.

Booth, A. E., & Waxman, S. R. (2003). Mapping words to the world in infancy: Infants' expectations for count nouns and adjectives. *Journal of Cognition and Development, 4,* 357–381. http://dx.doi.org/10.1207/S15327647JCD0403_06

Booth, A. E., & Waxman, S. R. (2009). A horse of a different color: Specifying with precision infants' mappings of novel nouns and adjectives. *Child Development, 80,* 15–22. http://dx.doi.org/10.1111/j.1467-8624.2008.01242.x

Brackett, M. A., Bertoli, M., Elbertson, N., Bausseron, E., Castillo, R., & Salovey, P. (2013). Emotional intelligence: Reconceptualizing the cognition-emotion link. In M. D. Robinson, E. R. Watkins, & E. Harmon-Jones (Eds.), *Handbook of cognition and emotion* (pp. 365–379). New York, NY: Guilford Press.

Brackett, M. A., Rivers, S. E., Reyes, M. R., & Salovey, P. (2012). Enhancing academic performance and social and emotional competence with the RULER feeling words curriculum. *Learning and Individual Differences, 22,* 218–224. http://dx.doi.org/10.1016/j.lindif.2010.10.002

Bradley, R. H., & Corwyn, R. F. (2002). Socioeconomic status and child development. *Annual Review of Psychology, 53,* 371–399. http://dx.doi.org/10.1146/annurev.psych.53.100901.135233

Bretherton, I., & Beeghly, M. (1982). Talking about internal states: The acquisition of an explicit theory of mind. *Developmental Psychology, 18,* 906–921. http://dx.doi.org/10.1037/0012-1649.18.6.906

Bridges, K. M. B. (1932). Emotional development in early infancy. *Child Development, 3,* 324–341. http://dx.doi.org/10.2307/1125359

Campos, J. J., Frankel, C. B., & Camras, L. (2004). On the nature of emotion regulation. *Child Development, 75,* 377–394. http://dx.doi.org/10.1111/j.1467-8624.2004.00681.x

Camras, L. A. (1992). Expressive development and basic emotions. *Cognition and Emotion, 6,* 269–283. http://dx.doi.org/10.1080/02699939208411072

Casasanto, D. (2008). Who's afraid of the big bad Whorf? Crosslinguistic differences in temporal language and thought. *Language Learning, 58,* 63–79. http://dx.doi.org/10.1002/9781444309645.ch6

Casasanto, D., & Bottini, R. (2014). Spatial language and abstract concepts. *Wiley Interdisciplinary Reviews: Cognitive Science, 5,* 139–149. http://dx.doi.org/10.1002/wcs.1271

Castro, V. L., Halberstadt, A. G., Lozada, F. T., & Craig, A. B. (2015). Parents' emotion-related beliefs, behaviors, and skills predict children's recognition of emotion. *Infant and Child Development, 24,* 1–22. http://dx.doi.org/10.1002/icd.1868

Chen, J. J. (2003). Communicating complex information: The interpretation of statistical interaction in multiple logistic regression analysis. *American Journal of Public Health, 93,* 1376–1377. http://dx.doi.org/10.2105/AJPH.93.9.1376-a

Clark, E. (1987). The principle of contrast: A constraint on language acquisition. In B. MacWhinney (Ed.), *Mechanisms of Language Acquisition* (pp. 1–33). Hillsdale, NJ: Erlbaum.

Cutting, A. L., & Dunn, J. (1999). Theory of mind, emotion understanding, language, and family background: Individual differences and interrelations. *Child Development, 70,* 853–865. http://dx.doi.org/10.1111/1467-8624.00061

Dapretto, M., Davies, M. S., Pfeifer, J. H., Scott, A. A., Sigman, M., Bookheimer, S. Y., & Iacoboni, M. (2006). Understanding emotions in others: Mirror neuron dysfunction in children with autism spectrum disorders. *Nature Neuroscience, 9,* 28–30. http://dx.doi.org/10.1038/nn1611

Denham, S. A., Zoller, D., & Couchoud, E. A. (1994). Socialization of preschoolers' emotion understanding. *Developmental Psychology, 30,* 928–936. http://dx.doi.org/10.1037/0012-1649.30.6.928

de Rosnay, M., & Harris, P. L. (2002). Individual differences in children's understanding of emotion: The roles of attachment and language. *Attachment & Human Development, 4,* 39–54. http://dx.doi.org/10.1080/14616730210123139

de Rosnay, M., Pons, F., Harris, P. L., & Morrell, J. M. B. (2004). A lag between understanding false belief and emotion attribution in young children: Relationships with linguistic ability and mothers' mental-state language. *British Journal of Developmental Psychology, 22,* 197–218. http://dx.doi.org/10.1348/026151004323044573

Doyle, C. M., & Lindquist, K. A. (2018). When a word is worth a thousand pictures: Language shapes perceptual memory for emotion. *Journal of Experimental Psychology: General, 147,* 62–73. http://dx.doi.org/10.1037/xge0000361

Dunn, J., Brown, J. R., & Beardsall, L. (1991). Family talk about feeling states and children's later understanding of others' emotions. *Developmental Psychology, 27,* 448–455. http://dx.doi.org/10.1037/0012-1649.27.3.448

Dunn, J., Brown, J., Slomkowski, C., Tesla, C., & Youngblade, L. (1991). Young children's understanding of other people's feelings and beliefs: Individual differences and their antecedents. *Child Development, 62,* 1352–1366. http://dx.doi.org/10.2307/1130811

Dunn, L. M., & Dunn, D. M. (2007). *The Peabody Picture Vocabulary Test, Fourth Edition*. Bloomington, MN: NCS Pearson, Inc.

Dunsmore, J. C., & Halberstadt, A. G. (1997). How does family emotional expressiveness affect children's schemas? In K. C. Barrett (Ed.), *The communication of emotion: Current research from diverse perspectives* (pp. 45–68). San Francisco, CA: Jossey-Bass. http://dx.doi.org/10.1002/cd.23219977704

Eggum, N. D., Eisenberg, N., Kao, K., Spinrad, T. L., Bolnick, R., Hofer, C., . . . Fabricius, W. V. (2011). Emotion understanding, theory of mind, and prosocial orientation: Relations over time in early childhood. *The Journal of Positive Psychology, 6,* 4–16. http://dx.doi.org/10.1080/17439760.2010.536776

Eisenberg, N., Sadovsky, A., & Spinrad, T. L. (2005). Associations of emotion-related regulation with language skills, emotion knowledge, and academic outcomes. *New Directions for Child and Adolescent Development, 2005,* 109–118. http://dx.doi.org/10.1002/cd.143

Ekman, P. (1992). An argument for basic emotions. *Cognition and Emotion, 6,* 169–200. http://dx.doi.org/10.1080/02699939208411068

Ekman, P., & Cordaro, D. (2011). What is meant by calling emotions basic. *Emotion Review, 3,* 364–370. http://dx.doi.org/10.1177/1754073911410740

Ellis, B. H., Alisic, E., Reiss, A., Dishion, T., & Fisher, P. A. (2014). Emotion regulation among preschoolers on a continuum of risk: The role of maternal emotion coaching. *Journal of Child and Family Studies, 23,* 965–974. http://dx.doi.org/10.1007/s10826-013-9752-z

Etkin, A., & Wager, T. D. (2007). Functional neuroimaging of anxiety: A meta-analysis of emotional processing in PTSD, social anxiety disorder, and specific phobia. *The American Journal of Psychiatry, 164,* 1476–1488. http://dx.doi.org/10.1176/appi.ajp.2007.07030504

Fenson, L., Marchman, V. A., Thal, D. J., Dale, P. S., Reznick, J. S., & Bates, E. (2007). *MacArthur-Bates communicative development inventories* (2nd ed.). Baltimore, MD: Paul H. Brookes.

Fisher, C. (2002). Structural limits on verb mapping: The role of abstract structure in 2.5-year-olds' interpretations of novel verbs. *Developmental Science, 5,* 55–64. http://dx.doi.org/10.1111/1467-7687.00209

Fisher, C., Gleitman, H., & Gleitman, L. R. (1991). On the semantic content of subcategorization frames. *Cognitive Psychology, 23,* 331–392. http://dx.doi.org/10.1016/0010-0285(91)90013-E

Fivush, R. (1991). Gender and emotion in mother—Child conversations about the past. *Journal of Narrative and Life History, 1,* 325–341. http://dx.doi.org/10.1075/jnlh.1.4.04gen

Fivush, R., Brotman, M. A., Buckner, J. P., & Goodman, S. H. (2000). Gender differences in parent–child emotion narratives. *Sex Roles, 42,* 233–253. http://dx.doi.org/10.1023/A:1007091207068

Fivush, R., Haden, C. A., & Reese, E. (2006). Elaborating on elaborations: Role of maternal reminiscing style in cognitive and socioemotional development. *Child Development, 77,* 1568–1588. http://dx.doi.org/10.1111/j.1467-8624.2006.00960.x

Fogel, A., Nwokah, E., Dedo, J. Y., Messinger, D., Dickson, K. L., Matusov, E., & Holt, S. A. (1992). Social process theory of emotion: A dynamic systems approach. *Social Development, 1,* 122–142. http://dx.doi.org/10.1111/j.1467-9507.1992.tb00116.x

Garrett-Peters, P. T., Castro, V. L., & Halberstadt, A. G. (2017). Parents' beliefs about children's emotions, children's emotion understanding, and classroom adjustment in middle childhood. *Social Development, 26,* 575–590. http://dx.doi.org/10.1111/sode.12222

Gendron, M., Mesquita, B., & Barrett, L. F. (2013). Emotion perception: Putting the face in context. In D. Reisberg (Ed.), *The Oxford handbook of cognitive psychology* (pp. 539–556). New York, NY: Oxford University Press. http://dx.doi.org/10.1093/oxfordhb/9780195376746.013.0034

Gendron, M., Roberson, D., van der Vyver, J. M., & Barrett, L. F. (2014). Perceptions of emotion from facial expressions are not culturally universal: Evidence from a remote culture. *Emotion, 14,* 251–262. http://dx.doi.org/10.1037/a0036052

Gentner, D. (1982). Why nouns are learned before verbs: Linguistic relativity versus natural partitioning. *Language Development, 2,* 301–334.

Gerken, L., & Shady, M. E. (1996). The picture selection task. In D. McDaniel, H. Smith Cairns, & C. McKee (Eds.), *Methods for assessing children's syntax. Language, speech, and communication* (pp. 125–146). Cambridge, MA: MIT Press.

Girden, E. R. (1992). *ANOVA: Repeated measures* (No. 84). Thousand Oaks, CA: Sage.

Gleitman, L. (1990). The structural sources of verb meanings. *Language Acquisition, 1,* 3–55. http://dx.doi.org/10.1207/s15327817la0101_2

Gleitman, L., Cassidy, K., Nappa, R., Papafragou, A., & Trueswell, J. (2005). Hard words. *Language Learning and Development, 1,* 23–64. http://dx.doi.org/10.1207/s15473341lld0101_4

Hagelskamp, C., Brackett, M. A., Rivers, S. E., & Salovey, P. (2013). Improving classroom quality with the RULER approach to social and emotional learning: Proximal and distal outcomes. *American Journal of Community Psychology, 51,* 530–543. http://dx.doi.org/10.1007/s10464-013-9570-x

Halberstadt, A. G., Denham, S. A., & Dunsmore, J. C. (2001). Affective social competence. *Social Development, 10,* 79–119. http://dx.doi.org/10.1111/1467-9507.00150

Halberstadt, A. G., & Lozada, F. T. (2011). Emotion development in infancy through the lens of culture. *Emotion Review, 3,* 158–168. http://dx.doi.org/10.1177/1754073910387946

Harris, P. L., De Rosnay, M., & Pons, F. (2005). Language and children's understanding of mental states. *Current Directions in Psychological Science, 14,* 69–73. http://dx.doi.org/10.1111/j.0963-7214.2005.00337.x

Harris, P. L., Johnson, C. N., Hutton, D., Andrews, G., & Cooke, T. (1989). Young children's theory of mind and emotion. *Cognition and Emotion, 3,* 379–400. http://dx.doi.org/10.1080/02699938908412713

Hirsh-Pasek, K., & Golinkoff, R. (1996). *The origins of grammar*. Cambridge, MA: MIT Press.

Hoff, E. (2003). The specificity of environmental influence: Socioeconomic status affects early vocabulary development via maternal speech. *Child Development, 74,* 1368–1378. http://dx.doi.org/10.1111/1467-8624.00612

Hutchinson, J. E. (1986). Children's sensitivity to the contrastive use of object category terms. *Papers and Reports on Child Language Development, 25,* 49–56.

Huttenlocher, J., & Smiley, P. (1987). Early word meanings: The case of object names. *Cognitive Psychology, 19,* 63–89. http://dx.doi.org/10.1016/0010-0285(87)90004-1

Izard, C. E. (2007). Basic emotions, natural kinds, emotion schemas, and a new paradigm. *Perspectives on Psychological Science, 2,* 260–280. http://dx.doi.org/10.1111/j.1745-6916.2007.00044.x

Jack, R. E., Garrod, O. G. B., Yu, H., Caldara, R., & Schyns, P. G. (2012). Facial expressions of emotion are not culturally universal. *Proceedings of the National Academy of Sciences of the United States of America, 109,* 7241–7244. http://dx.doi.org/10.1073/pnas.1200155109

Joormann, J. (2010). Cognitive inhibition and emotion regulation in depression. *Current Directions in Psychological Science, 19,* 161–166. http://dx.doi.org/10.1177/0963721410370293

Kashdan, T. B., Barrett, L. F., & McKnight, P. E. (2015). Unpacking emotion differentiation: Transforming unpleasant experience by perceiving distinctions in negativity. *Current Directions in Psychological Science, 24,* 10–16. http://dx.doi.org/10.1177/0963721414550708

Kayyal, M., Widen, S., & Russell, J. A. (2015). Context is more powerful than we think: Contextual cues override facial cues even for valence. *Emotion, 15,* 287–291. http://dx.doi.org/10.1037/emo0000032

La Barbera, J. D., Izard, C. E., Vietze, P., & Parisi, S. A. (1976). Four- and six-month-old infants' visual responses to joy, anger, and neutral expressions. *Child Development, 47,* 535–538. http://dx.doi.org/10.2307/1128816

Lewis, M., & Brooks, J. (1978). Self-knowledge and emotional development. In M. Lewis & L. A. Rosenblum (Eds.), *The development of affect* (pp. 205–226). Boston, MA: Springer. http://dx.doi.org/10.1007/978-1-4684-2616-8_8

Lindquist, K. A. (2013). Emotions emerge from more basic psychological ingredients: A modern psychological constructionist model. *Emotion Review, 5,* 356–368. http://dx.doi.org/10.1177/1754073913489750

Lindquist, K. A. (2017). The role of language in emotion: Existing evidence and future directions. *Current Opinion in Psychology, 17,* 135–139. http://dx.doi.org/10.1016/j.copsyc.2017.07.006

Lindquist, K. A., & Barrett, L. F. (2008). Emotional complexity. In M. Lewis, J. M. Haviland-Jones, & L. F. Barrett (Eds.), *Handbook of emotions* (3rd ed., pp. 513–530). New York, NY: Guilford Press.

Lindquist, K. A., Gendron, M., & Satpute, A. (2016). Language and emotion: Putting feelings into words and words into feelings. In M. Lewis, J. Haviland-Jones, & L. F. Barrett (Eds.), *Handbook of emotions* (4th ed., pp. 579–594). New York, NY: Guilford Press.

Lindquist, K. A., MacCormack, J. K., & Shablack, H. (2015). The role of language in emotion: Predictions from psychological constructionism. *Frontiers in Psychology*. Advance online publication. http://dx.doi.org/10.3389/fpsyg.2015.00444

Lindquist, K. A., Satpute, A. B., & Gendron, M. (2015). Does language do more than communicate emotion? *Current Directions in Psychological Science, 24,* 99–108. http://dx.doi.org/10.1177/0963721414553440

Lupyan, G. (2012a). Linguistically modulated perception and cognition: The label-feedback hypothesis. *Frontiers in Psychology*. Advance online publication. http://dx.doi.org/10.3389/fpsyg.2012.00054

Lupyan, G. (2012b). What do words do? Toward a theory of language-augmented thought. In B. H. Ross (Ed.), *Psychology of learning and motivation* (Vol. 57, pp. 255–297). New York, NY: Elsevier. http://dx.doi.org/10.1016/B978-0-12-394293-7.00007-8

Markman, E. M. (1990). Constraints children place on word meanings. *Cognitive Science, 14,* 57–77. http://dx.doi.org/10.1207/s15516709cog1401_4

Mennin, D. S., McLaughlin, K. A., & Flanagan, T. J. (2009). Emotion regulation deficits in generalized anxiety disorder, social anxiety disorder, and their co-occurrence. *Journal of Anxiety Disorders, 23,* 866–871. http://dx.doi.org/10.1016/j.janxdis.2009.04.006

Murphy, F. C., Sahakian, B. J., Rubinsztein, J. S., Michael, A., Rogers, R. D., Robbins, T. W., & Paykel, E. S. (1999). Emotional bias and inhibitory control processes in mania and depression. *Psychological Medicine, 29,* 1307–1321. http://dx.doi.org/10.1017/S0033291799001233

Naigles, L. (1990). Children use syntax to learn verb meanings. *Journal of Child Language, 17,* 357–374. http://dx.doi.org/10.1017/S0305000900013817

Naigles, L. R. (1996). The use of multiple frames in verb learning via syntactic bootstrapping. *Cognition, 58,* 221–251. http://dx.doi.org/10.1016/0010-0277(95)00681-8

Nathanson, L., Rivers, S. E., Flynn, L. M., & Brackett, M. A. (2016). Creating emotionally intelligent schools with RULER. *Emotion Review, 8,* 305–310. http://dx.doi.org/10.1177/1754073916650495

Nelson, N. L., & Russell, J. A. (2011). Preschoolers' use of dynamic facial, bodily, and vocal cues to emotion. *Journal of Experimental Child Psychology, 110,* 52–61. http://dx.doi.org/10.1016/j.jecp.2011.03.014

Panksepp, J. (1998). The preconscious substrates of consciousness: Affective states and the evolutionary origins of the self. *Journal of Consciousness Studies, 5,* 566–582.

Papafragou, A., Cassidy, K., & Gleitman, L. (2007). When we think about thinking: The acquisition of belief verbs. *Cognition, 105,* 125–165. http://dx.doi.org/10.1016/j.cognition.2006.09.008

Phillips, M. L., Drevets, W. C., Rauch, S. L., & Lane, R. (2003). Neurobiology of emotion perception II: Implications for major psychiatric disorders. *Biological Psychiatry, 54,* 515–528. http://dx.doi.org/10.1016/S0006-3223(03)00171-9

Pinker, S. (1984). *Language learnability and language development*. Cambridge, MA: Harvard University Press.

Plant, E. A., Hyde, J. S., Keltner, D., & Devine, P. G. (2000). The gender stereotyping of emotions. *Psychology of Women Quarterly, 24,* 81–92. http://dx.doi.org/10.1111/j.1471-6402.2000.tb01024.x

Pons, F., Harris, P. L., & de Rosnay, M. (2004). Emotion comprehension between 3 and 11 years: Developmental periods and hierarchical organization. *European Journal of Developmental Psychology, 1,* 127–152. http://dx.doi.org/10.1080/17405620344000022

Pons, F., Lawson, J., Harris, P. L., & de Rosnay, M. (2003). Individual differences in children's emotion understanding: Effects of age and language. *Scandinavian Journal of Psychology, 44,* 347–353. http://dx.doi.org/10.1111/1467-9450.00354

Quigley, K. S., Lindquist, K. A., & Barrett, L. F. (2013). Inducing and measuring emotion and affect: Tips, tricks, and secrets. In H. T. Reis & C. M. Judd (Eds.), *Handbook of Research Methods in Social and Personality Psychology* (pp. 220–252). http://dx.doi.org/10.1017/CBO9780511996481.014

Ridgeway, D., Waters, E., & Kuczaj, S. (1985). Acquisition of emotion-descriptive language: Receptive and productive vocabulary norms for ages 18 months to 6 years. *Developmental Psychology, 21,* 901–908. http://dx.doi.org/10.1037/0012-1649.21.5.901

Rivers, S. E., Brackett, M., Omori, M., Sickler, C., Bertoli, M. C., & Salovey, P. (2013). Emotion skills as a protective factor for risky behaviors among college students. *Journal of College Student Development, 54,* 172–183. http://dx.doi.org/10.1353/csd.2013.0012

Rivers, S. E., Brackett, M. A., Reyes, M. R., Elbertson, N. A., & Salovey, P. (2013). Improving the social and emotional climate of classrooms: A clustered randomized controlled trial testing the RULER Approach. *Prevention Science, 14,* 77–87. http://dx.doi.org/10.1007/s11121-012-0305-2

Rivers, S. E., Tominey, S. L., O'Bryon, E. C., & Brackett, M. A. (2013). Developing emotional skills in early childhood settings using Preschool RULER. *The Psychology of Education Review, 37,* 19–25.

Ruba, A. L., & Repacholi, M. M. (in press). Do preverbal infants understand discrete facial expressions of emotion? *Emotion Review*.

Russell, J. A. (2003). Core affect and the psychological construction of emotion. *Psychological Review, 110,* 145–172. http://dx.doi.org/10.1037/0033-295X.110.1.145

Russell, J. A., & Bullock, M. (1985). Multidimensional scaling of emotional facial expressions: Similarity from preschoolers to adults. *Journal of Personality and Social Psychology, 48,* 1290–1298. http://dx.doi.org/10.1037/0022-3514.48.5.1290

Russell, J. A., & Bullock, M. (1986). On the dimensions preschoolers use to interpret facial expressions of emotion. *Developmental Psychology, 22,* 97–102. http://dx.doi.org/10.1037/0012-1649.22.1.97

Russell, J. A., & Widen, S. C. (2002a). A label superiority effect in children's categorization of facial expressions. *Social Development, 11,* 30–52. http://dx.doi.org/10.1111/1467-9507.00185

Russell, J. A., & Widen, S. C. (2002b). Words versus faces in evoking preschool children's knowledge of the causes of emotions. *International Journal of Behavioral Development, 26,* 97–103. http://dx.doi.org/10.1080/01650250042000582

Salters-Pedneault, K., Roemer, L., Tull, M. T., Rucker, L., & Mennin, D. S. (2006). Evidence of broad deficits in emotion regulation associated with chronic worry and generalized anxiety disorder. *Cognitive Therapy and Research, 30,* 469–480. http://dx.doi.org/10.1007/s10608-006-9055-4

SAS Institute Inc. (2013). *SAS 9.4 Statements: Reference*. Cary, NC: SAS Institute Inc.

Shablack, H. (2017). *Linguistic and situational context assists emotion concept acquisition in preschoolers* (Unpublished master's thesis). University of North Carolina at Chapel Hill, Chapel Hill, NC.

Shablack, H., & Lindquist, K. A. (in press). The role of language in the development of emotion. In V. LoBue, K. Perez-Edgar, & K. Buss (Eds.), *Handbook of emotion development* (pp. 451–478). New York, NY: Springer.

Shablack, H., Stein, A. G., Lindquist, K. A., & Becker, M. (2019). *Adult discourse and linguistic cue influences on children's emotion word production: A study of naturalistic conversations*. Manuscript in preparation.

Steels, L., & Belpaeme, T. (2005). Coordinating perceptually grounded categories through language: A case study for colour. *Behavioral and Brain Sciences, 28,* 469–489. http://dx.doi.org/10.1017/S0140525X05000087

Syrett, K., Latourrette, A., Ferguson, B., & Waxman, S. R. (2018, November). *Crying helps, but being sad doesn't: Verbs, but not adjectives, constrain referent selection for novel nouns through age three*. Paper presented at the Boston University Conference on Language Development, Boston, MA.

Syrett, K., & Lidz, J. (2010). 30-month-olds use the distribution and meaning of adverbs to interpret novel adjectives. *Language Learning and Development, 6,* 258–282. http://dx.doi.org/10.1080/15475440903507905

Twenge, J. M., Catanese, K. R., & Baumeister, R. F. (2003). Social exclusion and the deconstructed state: Time perception, meaninglessness, lethargy, lack of emotion, and self-awareness. *Journal of Personality and Social Psychology, 85,* 409–423. http://dx.doi.org/10.1037/0022-3514.85.3.409

Vallacher, R. R., & Wegner, D. M. (1987). What do people think they're doing? Action identification and human behavior. *Psychological Review, 94,* 3–15. http://dx.doi.org/10.1037/0033-295X.94.1.3

Vallacher, R. R., & Wegner, D. M. (1989). Levels of personal agency: Individual variation in action identification. *Journal of Personality and Social Psychology, 57,* 660–671. http://dx.doi.org/10.1037/0022-3514.57.4.660

Wang, A. T., Dapretto, M., Hariri, A. R., Sigman, M., & Bookheimer, S. Y. (2004). Neural correlates of facial affect processing in children and adolescents with autism spectrum disorder. *Journal of the American Academy of Child & Adolescent Psychiatry, 43,* 481–490. http://dx.doi.org/10.1097/00004583-200404000-00015

Wegner, D. M., & Vallacher, R. R. (1987). The trouble with action. *Social Cognition, 5,* 179–190. http://dx.doi.org/10.1521/soco.1987.5.3.179

Weimer, A. A., Sallquist, J., & Bolnick, R. R. (2012). Young children's emotion comprehension and theory of mind understanding. *Early Education and Development, 23,* 280–301. http://dx.doi.org/10.1080/10409289.2010.517694

Weinberg, M. K., Tronick, E. Z., Cohn, J. F., & Olson, K. L. (1999). Gender differences in emotional expressivity and self-regulation during early infancy. *Developmental Psychology, 35,* 175–188. http://dx.doi.org/10.1037/0012-1649.35.1.175

Wellman, H. M., Harris, P. L., Banerjee, M., & Sinclair, A. (1995). Early understanding of emotion: Evidence from natural language. *Cognition & Emotion, 9,* 117–149. http://dx.doi.org/10.1080/02699939508409005

Widen, S. C. (2013). Children's interpretation of facial expressions: The long path from valence-based to specific discrete categories. *Emotion Review, 5,* 72–77. http://dx.doi.org/10.1177/1754073912451492

Widen, S. C., & Russell, J. A. (2003). A closer look at preschoolers' freely produced labels for facial expressions. *Developmental Psychology, 39,* 114–128. http://dx.doi.org/10.1037/0012-1649.39.1.114

Widen, S. C., & Russell, J. A. (2008). Children acquire emotion categories gradually. *Cognitive Development, 23,* 291–312. http://dx.doi.org/10.1016/j.cogdev.2008.01.002

Widen, S. C., & Russell, J. A. (2010). Children's scripts for social emotions: Causes and consequences are more central than are facial expressions. *British Journal of Developmental Psychology, 28,* 565–581. http://dx.doi.org/10.1348/026151009X457550d

Widen, S. C., & Russell, J. A. (2011). In building a script for an emotion, do preschoolers add its cause before its behavior consequence? *Social Development, 20,* 471–485. http://dx.doi.org/10.1111/j.1467-9507.2010.00594.x

Widen, S. C., & Russell, J. A. (2013). Children's recognition of disgust in others. *Psychological Bulletin, 139,* 271–299. http://dx.doi.org/10.1037/a0031640

Wilson-Mendenhall, C. D., Barrett, L. F., Simmons, W. K., & Barsalou, L. W. (2011). Grounding emotion in situated conceptualization. *Neuropsychologia, 49,* 1105–1127. http://dx.doi.org/10.1016/j.neuropsychologia.2010.12.032

Xu, F., & Kushnir, T. (2013). Infants are rational constructivist learners. *Current Directions in Psychological Science, 22,* 28–32. http://dx.doi.org/10.1177/0963721412469396

Yuan, S., & Fisher, C. (2009). "Really? She blicked the baby?": Two-year-olds learn combinatorial facts about verbs by listening. *Psychological Science, 20,* 619–626. http://dx.doi.org/10.1111/j.1467-9280.2009.02341.x

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