Current Psychology
https://doi.org/10.1007/s12144-022-03989-w

The acquisition of emotion-laden words from childhood to adolescence

Lucía Sabater[1] · Marta Ponari[2] · Juan Haro[3] · Uxia Fernández-Folgueiras[1,4] · Eva M. Moreno[1,6] · Miguel A. Pozo[1] · Pilar Ferré[3] · José A. Hinojosa[1,5,6]

Accepted: 29 October 2022

Abstract

Studies investigating how children acquire emotional vocabularies have mainly focused on words that describe feelings or affective states (emotion-label words, e.g., *joy*) trough subjective assessments of the children's lexicon reported by their parents or teachers. In the current cross-sectional study, we objectively examined the age of acquisition of words that relate to emotions without explicitly referring to affective states (emotion-laden words, e.g., *cake, tomb, rainbow*) using a picture naming task. Three hundred and sixty participants belonging to 18 age groups from preschool to adolescence overtly named line drawings corresponding to positive, negative, and neutral concrete nouns. The results of regression and mixed model analyses indicated that positive emotion-laden words are learnt earlier in life. This effect was independent of the contribution of other lexical and semantic factors (familiarity, word frequency, concreteness, word length). It is proposed that the prioritized acquisition of positive emotion-laden words might be the consequence of the communicative style and contextual factors associated with the interaction between children and caregivers. We also discuss the implications of our findings for proposals that highlight the role of language in emotion perception and understanding.

Keywords Emotion-laden words · Emotion-label words · Word acquisition · Positive words · Valence

Introduction

A critical motivation for infants to acquire language is to share and interpret thoughts and feelings about the objects, persons and events for which they care about. Children's affective experiences are closely related to word learning since they are central to the relationship with the personal and physical world (Beck et al., 2012; Bloom, 1998). At around 18 months, infants already have the ability to form associative links between novel labels and human facial configurations expressing emotions (Ruba et al., 2021). Immediately after, they begin to use emotion-descriptive language (Bretherton & Beeghly, 1982; Ridgeway et al., 1985).

The set of known words referring to affective concepts is referred to as *emotional lexicon.* A distinction is relevant between emotional words that directly denote affective states or describe feelings (emotion-label words, e.g. *sad* or *happy*; henceforth EM) and words with emotional connotations that do not convey specific emotional states (emotion-laden words, e.g., *candy* or *gun*; henceforth EL) (Pavlenko, 2008). This classification has received empirical support from behavioral and neurobiological studies (Altarriba & Basnight-Brown, 2011; Knickerbocker & Altarriba, 2013; Wang et al., 2019; Zhang et al., 2017, 2019; see Wu & Zhang, 2020, for a review). In this vein, the recognition of EM words is faster compared to the identification of EL words (Kazanas & Altarriba, 2015). EM words are also

✉ Lucía Sabater
sabater93@gmail.com

✉ José A. Hinojosa
hinojosa@pluri.ucm.es

[1] Instituto Pluridisciplinar, Universidad Complutense de Madrid, Madrid, Spain

[2] School of Psychology, University of Kent, Kent, UK

[3] Department of Psychology and CRAMC, Universitat Rovira I Virgili, Tarragona, Spain

[4] Facultad de Psicología, Universidad Autónoma de Madrid, Madrid, Spain

[5] Dpto. Psicología Experimental, Procesos Cognitivos Y Logopedia, Universidad Complutense de Madrid, Madrid, Spain

[6] Centro de Ciencia Cognitiva - C3, Universidad Nebrija, Madrid, Spain

Published online: 16 November 2022

associated to enhanced priming (Kazanas & Altarriba, 2015) and repetition blindness (Knickerbocker & Altarriba, 2013) effects than EL words. Finally, evidence from event-related potential studies have shown differences in short-latency components (e.g., N170, P2, Early Posterior Negativity) indicating processing differences between EM and EL words at early stages of word processing (Liu et al., 2022; Wang et al., 2019; Zhang et al., 2017).

Our knowledge about the development of the emotional lexicon is scarce. The acquisition of EM words has been examined by relying on subjective reports provided by parents (Baron-Cohen et al., 2010; Bretherton & Beeghly, 1982; Li & Yu, 2015; Ridgeway et al., 1985) or on children's assessment of their own knowledge (Baron-Cohen et al., 2010). A different approach was to ask children to list as many emotion words as they knew (Beck et al., 2012) or to define EM words (Nook et al., 2020). Finally, more objective estimations of the size and characteristics of the EM vocabulary were provided by testing children's ability to label faces, stories or vignettes describing feelings (Grosse et al., 2021; Streubel et al., 2020; Widen & Russell, 2003, 2008), listing as many emotion words as they knew (Beck et al., 2012) or asking definitions for EM words (Nook et al., 2020). Overall, these studies show that most children between 28 and 36 months have already learnt words describing feelings such as *funny*, *love* or *scared* (Bretherton & Beeghly, 1982; Nook et al., 2017; Ridgeway et al., 1985; Widen & Russell, 2003, 2008), and that EM vocabularies grow quickly at ages 4–11 (Baron-Cohen et al., 2010; Grosse et al., 2021; Li & Yu, 2015; Nook et al., 2020; Streubel et al., 2020). Also, EM words denoting positive affective states are learnt earlier in life compared to those expressing negative feelings (Baron-Cohen et al., 2010; Li & Yu, 2015). The advantage in the acquisition of positive relative to negative EM words might be associated with some features of the way in which mothers, fathers, and caregivers speak with infants and young children. In this sense, infant-directed speech typically conveys positive emotions (Golinkoff et al., 2015; Singh et al., 2002). Also, there is evidence showing that caregivers mainly use positive vocalizations and prosody to communicate with children (Dave et al., 2018; Kitamura & Lam, 2009; Saint-Georges et al., 2013), and that infants display a preference for melodic sound contours and vocalizations with positive emotional valence (e.g., approving) relative to those with negative emotional valence (e.g., disapproving) when listening to parental and adult speech (Fernald, 1993; Mumme & Fernald, 2003; Papoušek et al., 1990).

So far, however, little attention has been given to the acquisition of emotional-laden words that do not directly label affective states or feelings. Also, research on children's early lexical development has focused on questions such as the acquisition of words belonging to different grammatical categories (nouns and verbs; e.g., Imai et al., 2008) or the lexical and syntactic factors associated with vocabulary growth (e.g., Garlock et al., 2001), although these studies have neglected the affective properties of words. One exception are the studies by Ponari and colleagues who focused exclusively on abstract words. These authors reported that 7–9 years old children know more (Ponari et al., 2018) and learn better (Ponari et al., 2020) abstract positive EL words compared to neutral abstract words.

To go deeper in our understanding of the acquisition of EL words, in the current study we tested the ability of children from 32 months to 15 years of age to name line drawings denoting negative, neutral and positive Spanish EL concrete nouns.[1] Based on a dimensional approach to emotions in which valence (ranging from unpleasant/negative to pleasant/positive) and arousal (ranging from quiet to activated) are the main affective dimensions (Lang, 1995; Russell, 2003), we examined their role on the acquisition of EL words. In line with prior research showing that adults mainly communicate positive concepts and affect in their linguistic interactions with infants (Ponari et al., 2018), we expect that positive EL words are learnt earlier than both negative EL and neutral words. This finding would resemble that observed for EM words (Baron-Cohen et al., 2010; Li & Yu, 2015). Nonetheless, our hypothesis is tentative since there are no prior studies that systematically investigated this issue. Of note, the existence of processing differences between EM and EL words (Knickerbocker & Altarriba, 2013; Wang et al., 2019) suggests a distinct conceptual representation of these emotional vocabularies in the lexicon, and highlights the need to further investigate whether they share a similar pattern of acquisition in infancy and childhood. We hypothesize a lower contribution of arousal since there is evidence indicating that children's representation of emotions mainly relies on a positive–negative dichotomy whereas they place reduced emphasis in other affective dimensions (Nook et al., 2017). Additionally, we examined if the acquisition of EL words is mediated by lexical and semantic factors closely associated with word learning or the representation of emotional words such as word length, word frequency, familiarity, or concreteness (Alario et al., 2004; Hinojosa et al., 2020; Lotto et al., 2010).

Method

Participants

Data were collected from 360 Spanish preschool, school and high school children and adolescents (180 girls

[1] Although prior studies suggest that the rate of growth of EM vocabulary levels off between 12- and 16-years-old, we included participants up to 15 years since this is the first systematic approach to the acquisition of EL words.

Table 1 Age Bands and Mean Age. Each age band included a total of 20 participants (10 girls and 10 boys)

Age Group (in months)	Mean	*SD*
32–37	34	1.7
38–43	41	1.5
44–49	46	1.5
50–55	53	1.8
56–61	58	2.0
62–67	65	1.8
68–73	70	1.6
74–79	76	1.5
80–85	83	1.8
86–91	88	1.5
92–97	94	1.5
98–109	103	3.1
110–121	116	3.3
122–133	128	3.3
134–145	141	3.3
146–157	152	3.1
158–169	163	3.3
170–181	175	3.1

and 180 boys) from eight schools in the Comunidad de Madrid and one school from Galicia, Spain. Their ages ranged from 32 months (2 years 8 months) to 181 months (15 years 1 month). Children from ages of 32 months (2 years 8 months) to 97 months (8 years 1 month) were tested in 6-months age bands, whereas older children and adolescents were tested in 12-month age bands. Each of the 18 age bands included 20 children (10 girls and 10 boys). The sample size was established according to previous studies using picture naming tasks to investigate word acquisition (e.g., Álvarez & Cuetos, 2007; Lotto et al., 2010). Nonetheless, statistical power values were calculated post hoc for each analysis using G*Power (Faul et al., 2007), yielding values greater than 0.80 in all cases (assuming a medium effect size). Information about the 18 age bands is shown in Table 1. All participants were native Spanish speakers, had normal or corrected to normal vision and no history of developmental disorders, nor special educational needs. Children and adolescents lived in urban or suburban areas. Informed consent was obtained from parents. The study was performed in accordance with the ethical standards in the Declaration of Helsinki and approved by a local ethics committee at the *Instituto Pluridisciplinar*.

Stimuli

First, we selected positive, negative and neutral concrete EL words from several normative studies with adults reporting affective norms for Spanish words (Ferré et al., 2012; Guasch et al., 2016; Hinojosa et al., 2016; Redondo et al., 2007; Stadthagen-Gonzalezet al., 2017). These words could be easily and unequivocally represented by simple line drawings. We excluded words denoting descriptions of feelings and affective states, abstract words that were difficult to represent by simple line drawings (e.g., *peace* or *violence*), and words denoting emotional content that were judged as inappropriate for young children. After carefully scrutinizing these datasets, a total of 201 EL words were selected (67 negative: *spider*, *bullet*; 62 neutral: *comb*, *gloves*; and 72 positive: *dolphin, gift*; all nouns). Valence scores for negative words were below 4.03, scores for neutral words ranged from 4.03 to 6, and scores for positive words were above 6 (in a 9-points Likert scale ranging from 1 negative to 9 positive). In addition, we gathered adult ratings for arousal, concreteness (i.e., the degree to which a word denotes a perceptible entity), and familiarity (i.e., subjective exposure to a word) from Ferré et al. (2012), Guasch et al. (2016), Hinojosa et al. (2016), Redondo et al. (2007) and Stadthagen-Gonzalez et al. (2017), and log frequency (i.e., the number of times a particular word is encountered in a representative sample of texts or speech; here we used the logarithm to base 10 of word frequency) from EsPal (Duchon et al., 2013). The descriptive statistics of these variables are shown in Table 2.

Table 2 Descriptive statistics of the variables examined in the study

	N	Range	Mean	*SD*
Age of acquisition (months)	201	34.20—175.20	61.06	34.00
Valence	201	1.42—8.13	4.95	1.66
Arousal	201	2.55—7.79	4.98	1.11
Concreteness	157	4.10—6.85	5.94	0.59
Familiarity	157	1.47—6.95	4.47	1.28
Log frequency	201	0.03—2.45	1.01	0.57
No. letters	201	3—14	6.49	1.80

Subsequently, we collected from the internet a set of line drawings depicting those words to be used in the picture naming task. Several pictures were modified to keep the visual complexity similar for all stimuli by removing some parts that displayed objects or entities apart from those denoted by the target word, or by equating image size. Each drawing was presented in black and white on an independent DIN-A4 size sheet. Figure 1 shows some stimulus examples. The complete set of stimuli will be provided upon request.

Procedure

We followed a procedure used in prior picture naming studies investigating word acquisition (Álvarez & Cuetos,

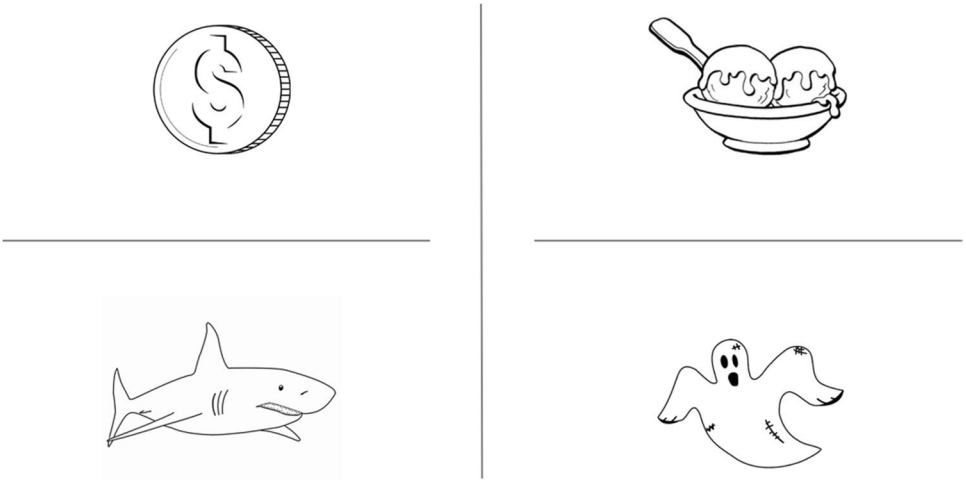

Fig. 1 Examples of stimuli. Upper panel: left'moneda' (coin), right'helado' (icecream); Lower panel; left'tiburón' (shark), right 'fantasma' (ghost)

2007; Lotto et al., 2010; Morrison et al., 1997). Children were tested individually in an empty classroom. They were told that the experimenter was going to show them several pictures. Thereafter, children were instructed to look carefully at each line drawing and to answer the following question: "How would you name what you see in the picture?". Following a standard procedure (Chalard et al., 2003; Morrison et al., 1997), a phonetic cue (e.g., the initial phoneme) was provided whenever children produced a synonym or if the name was on 'the tip of the tongue' to help them focus on the intended word related to a particular drawing. Prior research has shown high significant correlations for the age of acquisition of words between studies providing cues and those in which cues were not provided to children (Cannard & Kandel, 2008). Therefore, responses following cues were considered correct if children generated the appropriate word. Once the participant named the pictures, the experimenter coded the answers in an Excel spreadsheet (1 = correct answer; 0 = incorrect answer/unknown word). Children were regularly encouraged throughout the picture naming task. Younger children were allowed to rest whenever they were tired.

As in prior research (e.g., Álvarez & Cuetos, 2007), we started testing the 158 (13 years 2 months)-169 months (14 years 1 month) age group so that the youngest children had to name a smaller set of line drawings. We assumed that younger children would not be able to name those stimuli that older children could not name. The order of presentation of stimuli was randomized for each participant. Pictures were divided into two blocks with a 5-min rest break between blocks. Additional rest breaks were allowed upon request by children.

The age of acquisition for each word was determined using the 75% rule adopted in prior studies (Álvarez & Cuetos, 2007; Morrison et al., 1997). Once all stimuli were shown to each participant in an age group, correct and incorrect responses for each drawing were collated. Subsequently, we calculated the mean age of children in that group, as well as the average naming agreement for each picture. The age of acquisition of a particular word was considered to be the age of the youngest group in which at least 75% of the children could name the concept represented by the line drawing.

Results

Data is available at https://osf.io/u863v/. As shown in Fig. 2 the histogram of the age of acquisition suggests high positive skewness (skewness = 1.69, *SE* = 0.17), indicating that most words included in our study were acquired rather early in life (i.e., 75% of words have been learnt under 65.5 months). Table 3 shows a frequency distribution of the age of acquisition of words.

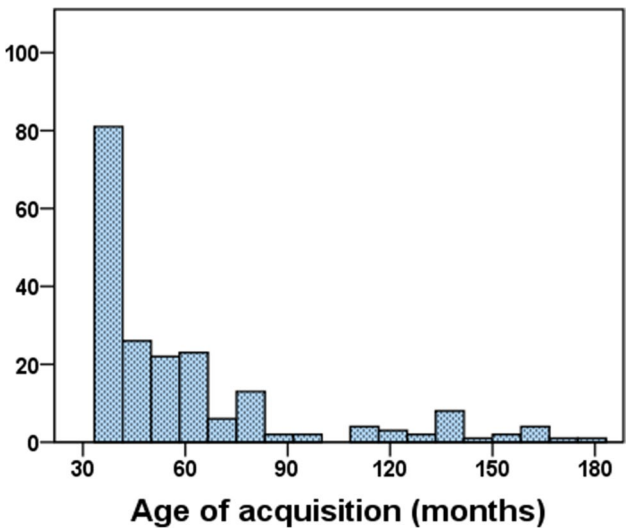

Fig. 2 Histogram of the age of acquisition

Table 3 Frequency distribution of the age of acquisition of words

Age of acquisition (months)	Frequency	Percent	Cumulative Percent
34.20	42	20.9	20.9
37.45	17	8.5	29.4
37.70	1	0.5	29.9
40.95	21	10.4	40.3
43.30	2	1.0	41.3
43.75	7	3.5	44.8
46.10	14	7.0	51.7
49.45	3	1.5	53.2
52.55	13	6.5	59.7
54.70	2	1.0	60.7
55.40	1	0.5	61.2
57.55	6	3.0	64.2
61.85	2	1.0	65.2
65.45	21	10.4	75.6
67.55	2	1.0	76.6
68.00	1	0.5	77.1
70.10	2	1.0	78.1
72.95	1	0.5	78.6
75.85	3	1.5	80.1
79.15	1	0.5	80.6
79.20	4	2.0	82.6
82.50	5	2.5	85.1
85.40	1	0.5	85.6
88.35	1	0.5	86.1
94.40	2	1.0	87.1
109.00	1	0.5	87.6
115.75	3	1.5	89.1
121.45	2	1.0	90.0
122.00	1	0.5	90.5
127.70	1	0.5	91.0
127.90	1	0.5	91.5
133.95	2	1.0	92.5
134.55	3	1.5	94.0
135.55	1	0.5	94.5
140.80	2	1.0	95.5
146.60	1	0.5	96.0
151.80	2	1.0	97.0
162.60	4	2.0	99.0
168.80	1	0.5	99.5
175.20	1	0.5	100.0

We examined the relationship between the age of acquisition of words and the affective dimensions of valence and arousal through a multiple regression analysis. We included several lexical and semantic variables such as concreteness, familiarity, log frequency and word length (number of letters), which exert different effects on word processing (e.g., Stadthagen-Gonzalez & Davis, 2006). This analysis was performed on a subset of 157 words for which values in all variables examined in this study were available. The age of acquisition of words was entered as a criterion, while valence, arousal, concreteness, familiarity, log frequency and number of letters were tested as predictors. We used the logarithm of the age of acquisition of words instead of the raw value since the original distribution of the values was positively skewed (see Fig. 2). Variables were introduced using the stepwise method. No multicollinearity was observed (tolerance > 0.66). The resulting regression model significantly predicted the age of acquisition of words, $F(4,152) = 16.71$, $p < 0.001$, explaining 31% of the total variance ($R^2 = 0.31$). The model included familiarity, number of letters, valence, and log frequency (see Table 4). The two variables with the highest predictive power were familiarity (R^2 change = 0.21) and number of letters (R^2 change = 0.04), adding a total of 25% of explained variance. Moreover, log frequency accounted for a 3% of the variance and showed a negative relationship with the age of acquisition of words. These results indicate an earlier acquisition of those words that for adults are more familiar, frequently used and shorter words (see Figs. 3, 4 and 5).

Importantly, valence explained a 3% of the variance and showed a negative relationship with the age of acquisition of words (see Fig. 6). This result indicates that words showing higher valence scores (positive words) for adults are acquired earlier in life. Of note, this relationship cannot be attributed to the effect of any other lexical or semantic variable examined in this study (e.g., word frequency, familiarity, number of letters, or concreteness). Supplementary materials show the results from additional analyses to further examine the consistency of valence effects on word acquisition, as well as the validity of our data with valence, arousal and word frequency norms from children aged 9- and 11- (Martínez & García, 2004; Sabater et al., 2020).

Discussion

The present study aimed to shed some light on children's gain of emotional vocabularies. Besides the contribution of lexical and semantic variables such as word frequency or word length (Alario et al., 2004; Morrison et al., 1997), we observed that familiarity had the highest predictive power of the age of acquisition of words. Our data indicates that words that are encountered more often in the linguistic environment are learnt earlier in life. This result is in agreement with previous developmental studies showing that children's experience with words plays a key role in the acquisition of language. In this sense, novel objects or events are more likely to be linked to familiar word forms to build new lexical representation (Bannard & Matthews, 2008; Bortfeld et al.,

Table 4 Coefficients of the multiple linear regression model

	b	95% CI	*SE*	*t*	*p*	R^2 change
Constant	2.02	(1.85; 2.19)	0.09	23.76	< 0.001	
Familiarity	-0.05	(-0.08; -0.03)	0.01	-4.42	< 0.001	0.21
No. Letters	0.02	(0.00; 0.03)	0.01	2.12	0.035	0.04
Valence	-0.02	(-0.04; -0.01)	0.01	-2.43	0.016	0.03
Log frequency	-0.06	(-0.11; 0.00)	0.03	-1.98	0.049	0.03

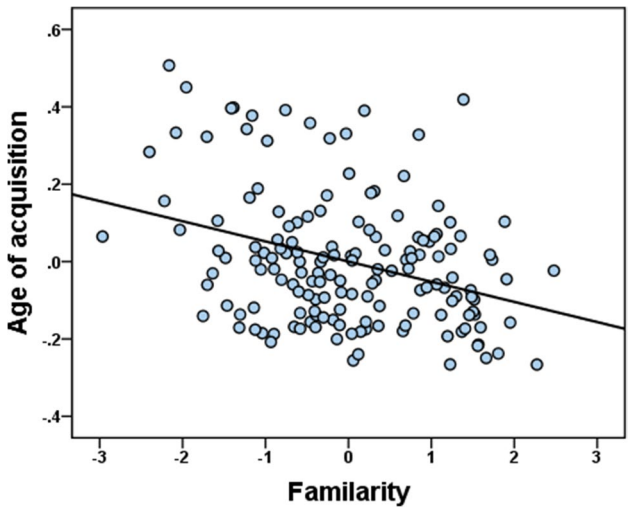

Fig. 3 Partial regression plot of familiarity. A partial regression plot shows the relationship between two variables included in a regression (the criterion and a predictor) after controlling for the effect of the other variables. Specifically, it shows the residuals of the criterion (on the Y-axis) and the residuals of the predictor (on the X-axis) when both variables are regressed on the rest of the predictors. Each dot represents a word, and the solid line shows the linear regression fit

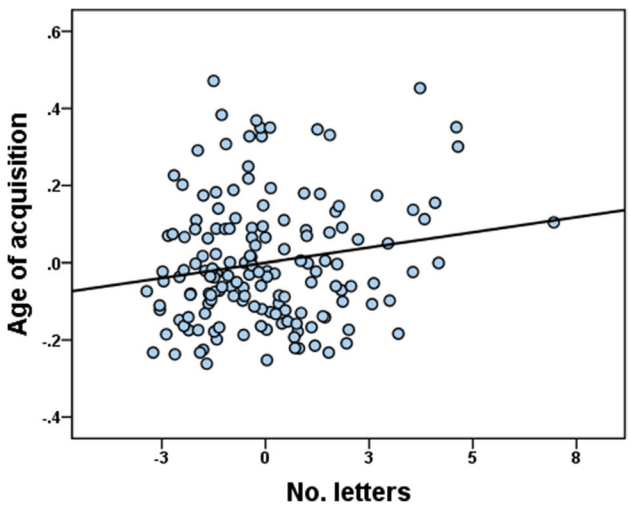

Fig. 4 Partial regression plot of number of letters. Each dot represents a word, and the solid line shows the linear regression fit

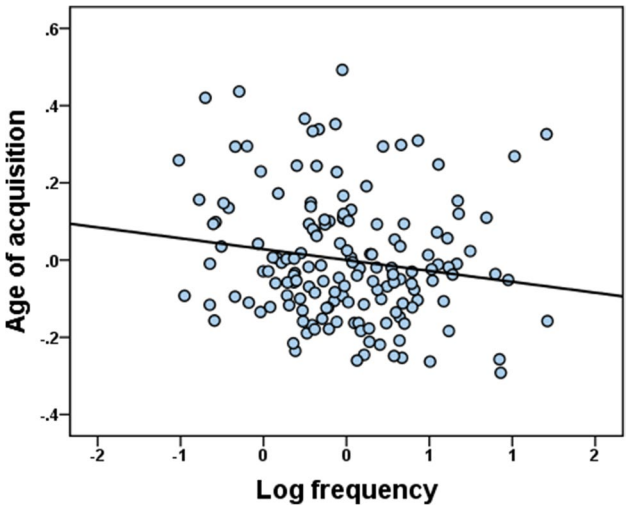

Fig. 5 Partial regression plot of log frequency. Each dot represents a word, and the solid line shows the linear regression fit

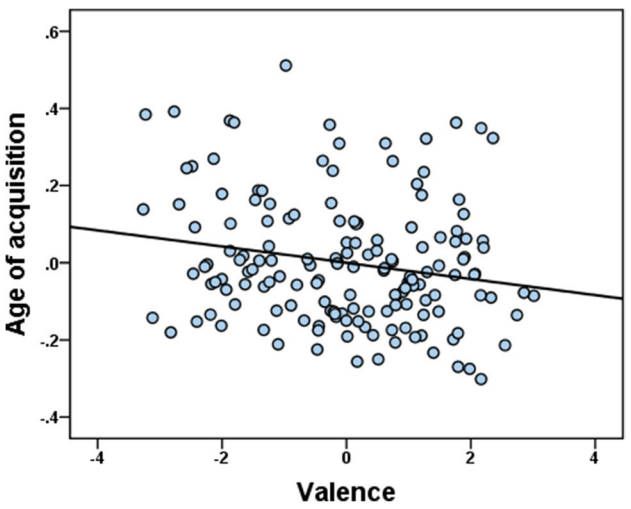

Fig. 6 Partial regression plot of valence. Each dot represents a word, and the solid line shows the linear regression fit

2013). Nonetheless, the main and novel finding of this study was the effect of valence in word acquisition, which is independent of the contribution of familiarity, word frequency, or word-length. In particular, words with a positive connotation

that do not explicitly express affective states were acquired earlier than negative or neutral words. In contrast, we failed to report effects of arousal to the acquisition of EL words, which is in line with evidence showing that emotional representations in young children mainly rely on the valence dimension (Grosse et al., 2021; Nook et al., 2017).

Prior studies examining the acquisition of EM words based on parents' or teachers' reports found that children learn words denoting positive feelings earlier that those describing negative or neutral affective states (Baron-Cohen et al., 2010; Li & Yu, 2015). Here, we extend prior knowledge by showing a similar acquisition advantage for positive EL words. In line with prior claims, this finding points to a role of EL words on the acquisition and representation of emotional concepts that describe affective states (Lindquist et al., 2016; Satpute & Lindquist, 2021). Besides, current results highlight the need to consider word affective features when answering questions such as the acquisition of noun and verb lexical categories in children (Bates et al., 1994; Imai et al., 2008). Finally, most research on emotion vocabulary development has focused on children who are English native speakers. Here we show that the advantage in the acquisition of positive words extends to Spanish vocabulary. This finding is in line with the results from multilingual analyses that reported similar trajectories in vocabulary development in languages such as English, French, Korean, Hebrew, or Spanish (Bornstein et al., 2004). Nonetheless, since these studies did not assess the acquisition of affective words, potential cross-cultural differences in the development of English and Spanish emotion vocabulary should be explicitly tested in multilingual comparative studies. In this sense, there are data indicating that the ability to recognize and understand others' emotions develops later in Spanish-speaking pre-schoolers relative to English-speaking peers (Downs et al., 2007).

Regarding the possible reasons for a positive advantage in the acquisition of EL words, there is evidence indicating that adults make extensive use of words denoting positive concepts when they speak to children. In this line, Ponari and collaborators (2018) examined the subcorpus of child-directed speech (MacWhinney, 2000) from the Language Data Exchange System (CHILDES) to show that more than half of the most frequent words in English were positive and none were negative. Of note, infant-directed speech reflects positive emotions through the use of specific intonation contours and certain parameters of the spectral composition (e.g., high mean fundamental frequency or pitch, proportion of high frequency energy), or increases in the speech rate (Dave et al., 2018; Fernald & Kuhl, 1987; Singh et al., 2002), as well as through exaggerated facial expressions (Tamis-LeMonda et al., 2014). It seems likely that caregivers convey EL words with positive referents (e.g., *toy* or *hug*) in ways to capture children's attention by emphasizing these features when uttering within the course of linguistic interactions with children. Since infants display an early and persistent preference towards these paralinguistic cues (Golinkoff et al., 2015; Mumme & Fernald, 2003; Singh et al., 2002) and for affectively positive stimuli (Singh et al., 2004), increased attention would facilitate children's mapping of EL words to their positive-valence referents and, in turn, growth in positive EL vocabulary. Also, within the embodied cognition framework (Pulvermüller, 2005; Simmons et al., 2005), children's positive experiences associated with words' referents could also improve the mapping between objects or events and their lexical labels in positive EL words. In sum, we speculate that a more frequent exposure to EL positive words with idiosyncratic prosodic features allows children to observe adult's use of positive EL words to label objects, persons, or events[2] (Hoemann et al., 2019). These interactions might play a 'bootstrapping' role that attracts children's interest and provides with a communicative context for the prioritized acquisition of EL words.

Current data have theoretical implications for those views arguing for a role of language in the development of emotion understanding (Beck et al., 2012; Hoemann et al., 2019; Ornaghi & Grazzani, 2013). In particular, theories of constructed emotions assume that conceptual knowledge associated with emotional words plays a key role in shaping the way people perceive emotions in themselves and others (Barrett et al., 2007; Lindquist et al., 2015; Shablack & Lindquist, 2019). In agreement with this view, several studies have reported a relationship between children's vocabulary size of words to label affective states and both their ability to recognize emotions and their knowledge of emotion regulation strategies (Grosse et al., 2021; Streubel et al., 2020). Accordingly, children's prioritized acquisition of positive EL and positive EM words might be related to the earlier recognition of positive emotions in several domains. In this sense, Widen (2013) has shown that by the third year of life children make a preferential use of the term *happy* to label facial expressions. Additionally, Denham and Couchoud (1990) reported that 2–4-years-old children identified more easily positive situations relative to negative situations in vignettes showing puppets expressing feelings. Finally, children were better at naming and pointing to happy facial expressions compared to expressions of sadness, fear, or anger (Camras & Allison, 1985; Vesker et al., 2018).

[2] We indirectly test this possibility by examining the relationship between word frequency and valence scores in 7-, 9-, and 11-year-old children (Martínez & García, 2004; Sabater et al., 2020). We observed a positive correlation in all age-groups (7-years-old, $r = .249$, $p = .003$; 9-years-old, $r = .384$, $p < .001$; 11-years-old, $r = .226$, $p = .007$), which suggest that positive words for children are those more frequently used by adults.

One limitation of this study is that the selection of the stimuli was based on affective scores from adults, which might not necessarily reflect how children perceived the emotional features of words. Although the question of when emotional vocabularies are learnt (e.g., Grosse et al., 2021; Li & Yu, 2015; Nook et al., 2020) is slightly different from the question of how children assess the affective features of words (e.g., Monnier & Syssau, 2017; Nook et al., 2017; Sabater et al., 2020), this is an intrinsic limitation of this line of research since it would be nearly impossible to collect valence and arousal ratings from infants and young children who do not understand these dimensions in the same way as adults do (Nook et al., 2017). There might be a similar concern regarding scores for some of the subjective lexico-semantic variables analysed in the current study (e.g., familiarity, concreteness). However, the results of our supplementary analyses conducted with valence and word frequency norms from 9- and 11- years-old children are informative here. Indeed, these analyses replicated positive valence effects on the age of acquisition of words independent of word frequency, suggesting that our findings are rather robust. Also, recent evidence suggests that word emotional valence in adults can be predicted by children´s representations of this affective dimension, and that valence judgements by children and adults are highly correlated (Martínez-Huertas et al., 2021). Nonetheless, current findings might also be relevant by at least showing that children learn earlier those EL words that for adults show positive connotations.

In conclusion, we observed that positive EL words were acquired earlier that both negative EL and neutral words, which might arise from prior exposure to words to label objects, animals, or persons with positive connotations during adults' interactions with children. New research may shed some light on the potential mediators that influence the prioritized acquisition of EL positive words such as verbal knowledge or general cognitive skills (Grosse et al., 2021; Nook et al., 2017). Also, further studies are needed to disentangle potential confounding variables including differences in the availability of visual referents for positive and negative EL words in child's environment or differences in word features that facilitate their acquisition such as iconicity (Nielsen & Dingemanse, 2021). Current results have also some methodological implications. In this sense, we provide a data source that might be useful for a broad community of researchers examining emotional language processing in both children and adults. Just to give a few examples, the age of acquisition of EL words reported here might be valuable for investigating aspects such as the acquisition of emotional words in second languages or the interaction between lexico-semantic variables and word emotional properties in language comprehension and production studies.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s12144-022-03989-w.

Acknowledgements The authors would like to thank Natalia Carrera and Raquel Díez for their help with the selection of the stimuli and data collection, and all schools that participated in the study.

Funding Open Access funding provided thanks to the CRUE-CSIC agreement with Springer Nature. This work was funded by the Ministerio de Ciencia, Innovación y Universidades under Grants [PGC2018-098558-B-I00, PGC2018-098876-B-100, PID2019-107206 GB-I00, RED2018-102615-T]; Comunidad de Madrid under Grant [H2019/HUM-5705]; and Universitat Rovira i Virgili under Grant [2018PFR-URV-B2-32].

Data availability Data from this study is fully available at https://osf.io/u863v/

Declarations

Ethics approval The study was performed in accordance with the ethical standards laid down in the Declaration of Helsinki and in accord with all applicable laws and rules governing psychological research in Spain. Ethical approval was waived by the local Ethics Committee of the Instituto Pluridisciplinar.

Consent to participate Written informed consent was obtained from the parents.

Consent for publication Informed consent included consent for publication.

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

References

Alario, F. X., Ferrand, L., Laganaro, M., New, B., Frauenfelder, U. H., & Segui, J. (2004). Predictors of picture naming speed. *Behavior Research Methods, Instruments, & Computers, 36*(1), 140–155. https://doi.org/10.3758/bf03195559

Altarriba, J., & Basnight-Brown, D. M. (2011). The representation of emotion vs. emotion-laden words in English and Spanish in the Affective Simon Task. *International Journal of Bilingualism, 15*(3), 310–328. https://doi.org/10.1177/1367006910379261

Álvarez, B., & Cuetos, F. (2007). Objective age of acquisition norms for a set of 328 words in Spanish. *Behavior Research Methods, 39*(3), 377–383. https://doi.org/10.3758/BF03193006

Bannard, C., & Matthews, D. (2008). Stored word sequences in language learning: The effect of familiarity on children's repetition of four-word combinations. *Psychological Science, 19*(3), 241–248. https://doi.org/10.1111/j.1467-9280.2008.02075.x

Baron-Cohen, S., Golan, O., Wheelwright, S., Granader, Y., & Hill, J. (2010). Emotion word comprehension from 4 to 16 years old: A developmental survey. *Frontiers in Evolutionary Neuroscience, 2*, 109. https://doi.org/10.3389/fnevo.2010.00109

Barrett, L. F., Lindquist, K. A., & Gendron, M. (2007). Language as context for the perception of emotion. *Trends in Cognitive Sciences, 11*(8), 327–332. https://doi.org/10.1016/j.tics.2007.06.003

Bates, E., Marchman, V., Thal, D., Fenson, L., Dale, P., Reznick, J., … Hartung, J. (1994). Developmental and stylistic variation in the composition of early vocabulary. *Journal of Child Language, 21*(1), 85–123. https://doi.org/10.1017/S0305000900008680

Beck, L., Kumschick, I. R., Eid, M., & Klann-Delius, G. (2012). Relationship between language competence and emotional competence in middle childhood. *Emotion, 12*(3), 503–514. https://doi.org/10.1037/a0026320

Bloom, L. (1998). Language development and emotional expression. *Pediatrics, 102*(5 Suppl E), 1272–1277.

Bornstein, M. H., Cote, L. R., Maital, S., Painter, K., Park, S. Y., Pascual, L., … & Vyt, A. (2004). Cross-linguistic analysis of vocabulary in young children: Spanish, Dutch, French, Hebrew, Italian, Korean, and American English. *Child Development*, *75*(4), 1115–1139. https://doi.org/10.1111/j.1467-8624.2004.00729.x

Bortfeld, H., Shaw, K., & Depowski, N. (2013). Disentangling the influence of salience and familiarity on infant word learning: Methodological advances. *Frontiers in Psychology, 4*, 175. https://doi.org/10.3389/fpsyg.2013.00175

Bretherton, I., & Beeghly, M. (1982). Talking about internal states: The acquisition of an explicit theory of mind. *Developmental Psychology, 18*(6), 906–921. https://doi.org/10.1037/0012-1649.18.6.906

Camras, L. A., & Allison, K. (1985). Children's understanding of emotional facial expressions and verbal labels. *Journal of Nonverbal Behavior, 9*(2), 84–94. https://doi.org/10.1007/BF00987140

Cannard, C., & Kandel, S. (2008). Impact of semantic or phonemic cues in picture-naming tasks on the calculation of the objective age-of-acquisition norms: A cross-linguistic study. *Behavior Research Methods, 40*(4), 1055–1064. https://doi.org/10.3758/BRM.40.4.1055

Chalard, M., Bonin, P., Méot, A., Boyer, B., & Fayol, M. (2003). Objective age-of-acquisition (AoA) norms for a set of 230 object names in French: Relationships with psycholinguistic variables, the English data from Morrison et al. (1997), and naming latencies. *European Journal of Cognitive Psychology, 15*(2), 209–245. https://doi.org/10.1080/09541440244000076

Dave, S., Mastergeorge, A., & Olswang, L. (2018). Motherese, affect, and vocabulary development: Dyadic communicative interactions in infants and toddlers. *Journal of Child Language, 45*(4), 917–938. https://doi.org/10.1017/S0305000917000551

Denham, S. A., & Couchoud, E. A. (1990). Young preschoolers' understanding of emotions. *Child Study Journal, 20*(3), 171–192. https://doi.org/10.1111/1469-7610.00139

Downs, A., Strand, P., & Cerna, S. (2007). Emotion understanding in English- and Spanish-speaking preschoolers enrolled in head start. *Social Development, 16*(3), 410–439. https://doi.org/10.1111/j.1467-9507.2007.00391.x

Duchon, A., Perea, M., Sebastián-Gallés, N., Martí, A., & Carreiras, M. (2013). EsPal: One-stop shopping for Spanish word properties. *Behavior Research Methods, 45*, 1246–1258. https://doi.org/10.3758/s13428-013-0326-1

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*, 175–191. https://doi.org/10.3758/BF03193146

Fernald, A. (1993). Approval and disapproval: Infant responsiveness to vocal affect in familiar and unfamiliar languages. *Child Development, 64*(3), 657–674. https://doi.org/10.1111/j.1467-8624.1993.tb02934.x

Fernald, A., & Kuhl, P. (1987). Acoustic determinants of infant preference for motherese speech. *Infant Behavior and Development, 10*(3), 279–293. https://doi.org/10.1016/0163-6383(87)90017-8

Ferré, P., Guasch, M., Moldovan, C., & Sánchez-Casas, R. (2012). Affective norms for 380 Spanish words belonging to three different semantic categories. *Behavior Research Methods, 44*, 395–403. https://doi.org/10.3758/s13428-011-0165-x

Garlock, V. M., Walley, A. C., & Metsala, J. L. (2001). Age-of-acquisition, word frequency, and neighborhood density effects on spoken word recognition by children and adults. *Journal of Memory and Language, 45*(3), 468–492. https://doi.org/10.1006/jmla.2000.2784

Golinkoff, R. M., Can, D. D., Soderstrom, M., & Hirsh-Pasek, K. (2015). (Baby) talk to me: The social context of infant-directed speech and its effects on early language acquisition. *Current Directions in Psychological Science, 24*(5), 339–344. https://doi.org/10.1177/0963721415595345

Grosse, G., Streubel, B., Gunzenhauser, C., et al. (2021). Let's talk about emotions: The development of children's emotion vocabulary from 4 to 11 years of age. *Affective Science*. https://doi.org/10.1007/s42761-021-00040-2

Guasch, M., Ferré, P., & Fraga, I. (2016). Spanish norms for affective and lexico-semantic variables for 1,400 words. *Behavior Research Methods, 48*(4), 1358–1369. https://doi.org/10.3758/s13428-015-0684-y

Hinojosa, J. A., Martínez-García, N., Villalba-García, C., Fernández-Folgueiras, U., Sánchez-Carmona, A., Pozo, M. A., & Montoro, P. R. (2016). Affective norms of 875 Spanish words for five discrete emotional categories and two emotional dimensions. *Behavior Research Methods, 48*, 272–284. https://doi.org/10.3758/s13428-015-0572-5

Hinojosa, J. A., Moreno, E. M., & Ferré, P. (2020). Affective Neurolinguistics: Towards a framework for reconciling language and emotion. *Language, Cognition and Neuroscience, 35*, 813–839. https://doi.org/10.1080/23273798.2019.1620957

Hoemann, K., Xu, F., & Barrett, L. (2019). Emotion words, emotion concepts, and emotional development in children: A constructionist hypothesis. *Developmental Psychology, 55*, 1830–1849. https://doi.org/10.1037/dev0000686

Imai, M., Li, L., Haryu, E., Okada, H., Hirsh-Pasek, K., Golinkoff, R. M., & Shigematsu, J. (2008). Novel noun and verb learning in Chinese-, English-, and Japanese-speaking children. *Child Development, 79*(4), 979–1000. https://doi.org/10.1111/j.1467-8624.2008.01171.x

Kazanas, S. A., & Altarriba, J. (2015). The automatic activation of emotion and emotion-laden words: Evidence from a masked and unmasked priming paradigm. *The American Journal of Psychology, 128*(3), 323–336. https://doi.org/10.5406/amerjpsyc.128.3.0323

Kitamura, C., & Lam, C. (2009). Age-specific preferences for infant-directed affective intent. *Infancy, 14*(1), 77–100. https://doi.org/10.1080/15250000802569777

Knickerbocker, H., & Altarriba, J. (2013). Differential repetition blindness with emotion and emotion-laden word types. *Visual Cognition, 21*(5), 599–627. https://doi.org/10.1080/13506285.2013.815297

Lang, P. J. (1995). The emotion probe: Studies of motivation and attention. *American Psychologist, 50*(5), 372. https://doi.org/10.1037//0003-066x.50.5.372

Li, Y., & Yu, D. (2015). Development of emotion word comprehension in Chinese children from 2 to 13 years old: Relationships with valence and empathy. *PLoS ONE, 10*(12), e0143712. https://doi.org/10.1371/journal.pone.0143712

Lindquist, K. A., MacCormack, J. K., & Shablack, H. (2015). The role of language in emotion: Predictions from psychological constructionism. *Frontiers in Psychology, 6*,. https://doi.org/10.3389/fpsyg.2015.00444

Lindquist, K. A., Gendron, M., & Satpute, A. B. (2016). Language and emotion. In M. Lewis, J. Haviland-Jones, & L. F. Barrett (Eds.), *Handbook of emotions* (4th ed., pp. 579–594). The Guilford Press.

Liu, J., Fan, L., Tian, L., Li, C., & Feng, W. (2022). The neural mechanisms of explicit and implicit processing of Chinese emotion-label and emotion-laden words: Evidence from emotional categorisation and emotional Stroop tasks. *Language, Cognition and Neuroscience*. https://doi.org/10.1080/23273798.2022.2093389

Lotto, L., Surian, L., & Job, R. (2010). Objective age of acquisition for 223 Italian words: Norms and effects on picture naming speed. *Behavior Research Methods, 42*(1), 126–133. https://doi.org/10.3758/BRM.42.1.126

MacWhinney, B. (2000). *The CHILDES project: The database* (Vol. 2). Psychology Press.

Martínez, J. A., & García, E. M. (2004). Diccionario frecuencias del castellano escrito en niños de 6 a 12 años. Servicio de Publicaciones Universidad Pontificia de Salamanca.

Martínez-Huertas, J. Á., Jorge-Botana, G., & Olmos, R. (2021). Emotional valence precedes semantic maturation of words: A longitudinal computational study of early verbal emotional anchoring. *Cognitive Science, 45*(7), e13026. https://doi.org/10.1111/cogs.13026

Monnier, C., & Syssau, A. (2017). Affective norms for 720 French words rated by children and adolescents (FANchild). *Behavior Research Methods, 49*(5), 1882–1893. https://doi.org/10.3758/s13428-016-0831-0

Morrison, C. M., Chappell, T. D., & Ellis, A. W. (1997). Age of acquisition norms for a large set of object names and their relation to adult estimates and other variables. *The Quarterly Journal of Experimental Psychology Section A, 50*(3), 528–559. https://doi.org/10.1080/027249897392017

Mumme, D. L., & Fernald, A. (2003). The infant as onlooker: Learning from emotional reactions observed in a television scenario. *Child Development, 74*(1), 221–237. https://doi.org/10.1111/1467-8624.00532

Nielsen, A. K., & Dingemanse, M. (2021). Iconicity in word learning and beyond: A critical review. *Language and Speech, 64*(1), 52–72. https://doi.org/10.1177/0023830920914339

Nook, E. C., Sasse, S. F., Lambert, H. K., McLaughlin, K. A., & Somerville, L. H. (2017). Increasing verbal knowledge mediates development of multidimensional emotion representations. *Nature Human Behaviour, 1*(12), 881–889. https://doi.org/10.1038/s41562-017-0238-7

Nook, E. C., Stavish, C. M., Sasse, S. F., Lambert, H. K., Mair, P., McLaughin, K. A., & Somerville, L. H. (2020). Charting the development of emotion comprehension and abstraction from childhood to adulthood using observer-rated and linguistic measures. *Emotion, 20*(5), 773–792. https://doi.org/10.1037/emo0000609

Ornaghi, V., & Grazzani, I. (2013). The relationship between emotional-state language and emotion understanding: A study with school-age children. *Cognition & Emotion, 27*(2), 356–366. https://doi.org/10.1080/02699931.2012.711745

Papoušek, M., Bornstein, M. H., Nuzzo, C., Papoušek, H., & Symmes, D. (1990). Infant responses to prototypical melodic contours in parental speech. *Infant Behavior and Development, 13*(4), 539–545. https://doi.org/10.1016/0163-6383(90)90022-Z

Pavlenko, A. (2008). Emotion and emotion-laden words in the bilingual lexicon. *Bilingualism: Language and Cognition, 11*(2), 147–164. https://doi.org/10.1017/S1366728908003283

Ponari, M., Norbury, C. F., & Vigliocco, G. (2018). Acquisition of abstract concepts is influenced by emotional valence. *Developmental Science, 21*(2), e12549. https://doi.org/10.1111/desc.12549

Ponari, M., Norbury, C., & Vigliocco, G. (2020). The role of emotional valence in learning novel abstract concepts. *Developmental Psychology, 56*(10), 1855–1865. https://doi.org/10.1037/dev0001091

Pulvermüller, F. (2005). Brain mechanisms linking language and action. *Nature Reviews Neuroscience, 6*, 576–582. https://doi.org/10.1038/nrn1706

Redondo, J., Fraga, I., Padrón, I., & Comesaña, M. (2007). The Spanish adaptation of ANEW (Affective Norms for English Words). *Behavior Research Methods, 39*, 600–605. https://doi.org/10.3758/bf03193031

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

Ruba, A. L., Harris, L. T., & Wilbourn, M. P. (2021). Examining preverbal infants' ability to map labels to facial configurations. *Affective Science, 2*, 142–149. https://doi.org/10.1007/s42761-020-00015-9

Russell, J. A. (2003). Core affect and the psychological construction of emotion. *Psychological Review, 110*(1), 145–172. https://doi.org/10.1037/0033-295X.110.1.145

Sabater, L., Guasch, M., Ferré, P., Fraga, I., & Hinojosa, J. A. (2020). Spanish affective normative data for 1,406 words rated by children and adolescents (SANDchild). *Behavior Research Methods, 52*(5), 1939–1950. https://doi.org/10.3758/s13428-020-01377-5

Saint-Georges, C., Chetouani, M., Cassel, R., Apicella, F., Mahdhaoui, A., Muratori, F., Laznik, M. C., & Cohen, D. (2013). Motherese in interaction: at the cross-road of emotion and cognition? (A systematic review). *PloS One,8*(10), e78103. https://doi.org/10.1371/journal.pone.0078103

Satpute, A. B., & Lindquist, K. A. (2021). At the neural intersection between language and emotion. *Affective Science*. https://doi.org/10.1007/s42761-021-00032-2

Shablack, H., & Lindquist, K. A. (2019). The role of language in emotional development. In *Handbook of emotional development* (pp. 451–478). Springer, Cham. https://doi.org/10.1007/978-3-030-17332-6_18

Simmons, W. K., Martin, A., & Barsalou, L. W. (2005). Pictures of appetizing foods activate gustatory cortices for taste and reward. *Cerebral Cortex, 15*, 1602–1608. https://doi.org/10.1093/cercor/bhi038

Singh, L., Morgan, J. L., & Best, C. T. (2002). Infants' listening preferences: Baby talk or happy talk? *Infancy, 3*(3), 365–394. https://doi.org/10.1207/S15327078IN0303_5

Singh, L., Morgan, J. L., & White, K. S. (2004). Preference and processing: The role of speech affect in early spoken word recognition. *Journal of Memory and Language, 51*(2), 173–189. https://doi.org/10.1016/j.jml.2004.04.004

Stadthagen-Gonzalez, H., Imbault, C., Pérez Sánchez, M. A., & Brysbaert, M. (2017). Norms of valence and arousal for 14,031 Spanish words. *Behavior Research Methods, 49*, 111–123. https://doi.org/10.3758/s13428-015-0700-2

Stadthagen-Gonzalez, H., & Davis, C. J. (2006). The Bristol norms for age of acquisition, imageability, and familiarity. *Behavior Research Methods, 38*(4), 598–605. https://doi.org/10.3758/BF03193891

Streubel, B., Gunzenhauser, C., Grosse, G., & Saalbach, H. (2020). Emotion-specific vocabulary and its contribution to emotion understanding in 4- to 9-year-old children. *Journal of Experimental Child Psychology, 193*, 104790. https://doi.org/10.1016/j.jecp.2019.104790

Tamis-LeMonda, C. S., Kuchirko, Y., & Song, L. (2014). Why is infant language learning facilitated by parental responsiveness? *Current Directions in Psychological Science, 23*(2), 121–126. https://doi.org/10.1177/0963721414522813

Vesker, M., Bahn, D., Degé, F., Kauschke, C., & Schwarzer, G. (2018). Perceiving arousal and valence in facial expressions: Differences

between children and adults. *European Journal of Developmental Psychology, 15*(4), 411–425.

Wang, X., Shangguan, C., & Lu, J. (2019). Time course of emotion effects during emotion-label and emotion-laden word processing. *Neuroscience Letters, 699*, 1–7. https://doi.org/10.1016/j.neulet.2019.01.028

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. https://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*(1), 114–128. https://doi.org/10.1037//0012-1649.39.1.114

Widen, S. C., & Russell, J. A. (2008). Children acquire emotion categories gradually. *Cognitive Development, 23*(2), 291–312. https://doi.org/10.1016/j.cogdev.2008.01.002

Wu, C., & Zhang, J. (2020). Emotion word type should be incorporated in affective neurolinguistics: A commentary on Hinojosa, Moreno and Ferré (2019). *Language, Cognition, and Neuroscience, 35*(7), 840–843. https://doi.org/10.1080/23273798.2019.1696979

Zhang, J., Wu, C., Meng, Y., & Yuan, Z. (2017). Different neural correlates of emotion-label words and emotion-laden words: An ERP study. *Frontiers in Human Neuroscience, 11*, 455. https://doi.org/10.3389/fnhum.2017.00455

Zhang, J., Wu, C., Yuan, Z., & Meng, Y. (2019). Differentiating emotion-label words and emotion-laden words in emotion conflict: An ERP study. *Experimental Brain Research, 237*(9), 2423–2430. https://doi.org/10.1007/s00221-019-05600-4