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Adults' Implicit Associations to Infant Positive and Negative Acoustic Cues: Moderation by Empathy and Gender

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Abstract

In this study a novel auditory version of the Single Category Implicit Association Test (SC-IAT-A) was developed to investigate (a) the valence of adults' associations to infant cries and laughs, (b) moderation of implicit associations by gender and empathy, and (c) the robustness of implicit associations controlling for auditory sensitivity. Eighty adults (50% females) were administered two SC-IAT-As, the Empathy Quotient, and the Weinstein Noise Sensitivity Scale. Adults showed positive implicit associations to infant laugh, and negative ones to infant cry; only the implicit associations with the infant laugh were negatively related to empathy scores, and no gender differences were observed. Finally, implicit associations to infant cry were affected by noise sensitivity. The SC-IAT-A is useful to evaluate the valence of implicit reactions to infant auditory cues and could provide fresh insights into understanding processes that regulate the quality of adult-infant relationships.

Keywords

Implicit Affective Associations; Infant Cry; Infant Laugh; Single Category Implicit Association Test; Auditory

Adult reactions to infant cues are among the most biologically relevant and adaptive human behaviours. Infants are not self-sufficient at birth, but need adults who are normally prone to respond in a timely and prompt manner to infants' needs or requests and to act in adequate and sensitive ways to ensure infant survival and wholesome development. Ethological studies show that caregiving behaviours are observed across a wide swath of mammalian and primate species strongly supporting their roots in biological functioning (Bornstein, 2013, 2015; Bowlby, 1969).

Despite a strong disposition to infant caregiving, the quality of adult-child interactions is sometimes compromised. Adults may show low warmth or sensitivity, rejection or disengaged caregiving, behaviours that usually have negative effects on child development (see Barnow, Lucht, & Freyberger, 2005; Beck & Shaw, 2005). Caregiver reactions to distressing stimuli produced by infants predict child outcomes (Leerkes, Parade, & Gudmundson, 2011; McElwain & Booth-Laforce, 2006), and emotional reactions to baby cues predict later attachment security (Leerkes et al., 2011). Taken together, individual differences in ways that adults react to babies suggest that investigating adults' reactions to infant cues might prove useful to better understand processes that regulate the quality of adult-child interactions, and consequently more clearly define possible interventions to promote more positive and sensitive caregiving.

Swain et al. (2014) reviewed human and animal studies investigating brain responses to infant signals and proposed a neurological model of the parental brain. According to that model, infant cues activate cortical and subcortical structures that determine the salience of the sensory input, trigger caregiving, regulate emotions, and engender cognitions.

Among diverse infant cues, cries have received much attention because the cry is a primary means of agency and communication in human infants (Zeifman, 2001). Infant cry is certainly aversive, and it can provoke maltreatment (Kadushin & Martin, 1981), but it is also an evolutionarily developed signal that triggers solicitous caregiving in adults (Zeifman, 2001). Research that has investigated adult reactions to infant cry has largely focused on subjective evaluations (see Boukydis, 1985), physiological markers of autonomic arousal (Frodi et al., 1978; Frodi & Lamb, 1980), and (recently) brain responses (for ERP, see Maupin, Hayes, Mayes, & Rutherford, 2014; for fMRI see Swain et al., 2014). Compared to other matched control stimuli, adults respond to infant cries in specific ways (de Pisapia et al., 2013; Swain et al., 2014), and their reactions are influenced by characteristics of the cry (e.g., Esposito, Nakazawa, Venuti, & Bornstein, 2013) as well as by individual-difference factors (see Boukydis & Burgess, 1982).

With respect to individual factors, among the others, caregiver gender is relevant because it can help to explain the extent to which reactions to infant cry are related to biological or cultural determinants. Studies that have investigated effects of gender have produced mixed

results. Boukydis and Burgess (1982) investigated adult (parent and non-parent) physiological responses and self-reports to infant cry and found that men reported more irritation/anger than women, but they observed no gender difference in physiological arousal. Seifritz et al. (2003), using fMRI, investigated whether gender moderated adult (parent and non-parent) brain responses to infant cry and laughing; women (not men) showed a significant response to crying and laughing in the right anterior cingulate to the right mesial prefrontal cortex. de Pisapia et al. (2013) used fMRI to investigate adult (parent and non-parent) brain activity during exposure to infant hunger cries and atypical cries compared to rest and white noise; they found a decrease in brain activity of dorsal medial prefrontal cortex and the posterior cingulate cortex in females but not in males. Cohen-Bendahan, van Doornen, and de Weerth (2014) found no effect of gender in a study that investigated self-reports of sympathy/anger to infant crying in childless young adults.

To revisit and help clarify this literature, for this study we modified an existing sensitive paradigm, the Implicit Association Test (IAT), a computer-based measure designed to evaluate in an indirect way the valence of person's mental representations of target objects in memory (for a detailed introduction of the IAT see the seminal work of Greenwald, McGhee, & Schwartz, 1998). The IAT attempts to access traces of past experience that may be inaccessible to conscious introspection or that individuals would not overtly exhibit, but that implicitly mediate action, feeling, or thought toward target objects (Greenwald & Banaji, 1995). The IAT is a two-stage classification task developed on the same logic as other cognitive priming methods to measure implicit attitudes about target stimuli. In the IAT, people are asked to rapidly categorize two target objects (e.g., "adult" and "infant") and two attributes (e.g., "positive" and "negative") with only two response keys. In the first stage the first target object is classified with the same key of the first attribute, and in the second stage the second target object is classified with the same key of the first attribute. The implicit attitude, also referred to as the IAT effect, is derived from the comparison of latencies of responses between the two stages. The logic is that the object-attribute pair with the shorter classification latency (faster response) is interpreted as more strongly associated in memory than the pair with longer latency (slower response). Because the IAT requires that people make a series of rapid classification judgments, and because it is an indirect measure of attitude, it circumvents deliberative processes and reduces the impact of social desirability bias. Greenwald, Poehlman, Uhlmann, and Banaji (2009) showed that IAT scores predicted both controlled and spontaneous social behaviours over and above self-report measures (incremental validity).

Senese et al. (2013) adapted the Single Category Implicit Association Test (SC-IAT; Karpinski & Steinman, 2006), a modification of the Implicit Association Test, to evaluate the positive and negative valence of adult implicit associations to infant visual cues. In their work, Senese et al. (2013) used the SC-IAT because it allows the evaluation of a single category or attitude object at time. They tested adults with faces of infant and adult humans and infrahuman animals and found that human infant faces are implicitly and uniquely associated with greater positive valence and that individual differences in implicit reactions correlated with expressed desires to interact socially with infants. To our knowledge, however, no study has investigated the implicit valence of infant auditory cues. Infant

auditory cues are significant because infant cries and other vocal sounds constitute early means of infant agency.

The main aim of the present study was, therefore, to investigate the valence of adults' implicit reactions to infant cries and laughs. To meet this aim, we developed an auditory version of the SC-IAT paradigm. We recruited non-parent adults to participate because we wanted to investigate implicit reactions independent of parental status and experience. In accord with the previous literature, we expected to find positive reactions to infant laughs and negative reactions to infant cries (Senese et al., 2013), and to find gender differences to both (Seifritz et al., 2003; de Pisapia et al., 2013), with males showing a more negative reactions to infant cry and fewer positive reactions to infant laugh.

According to the parental brain model (Swain et al., 2014), empathy likely moderates brain responses to infant cues. We therefore also asked if implicit reactions to infant cues are moderated by stable empathy levels. Emery, McElwain, Groh, Haydon, and Roisman (2014) measured maternal skin conductance associated with cry–laugh auditory stimuli and found that empathy moderated reactivity. We expected a similar effect, with low empathy participants showing less adaptive reactions to infant stimuli (see Dix, 1991).

Finally, because this investigation focuses on adults' reactions to infant auditory cues, and infant cry is aversive, we measured subjective noise sensitivity in participants (Senese, Ruotolo, Ruggiero, & Iachini, 2012) to control its effects on implicit reactions. To our knowledge, this is the first study to examine gender differences in adults' reactions to infant auditory cues that take into account possible confounding effects of individual noise sensitivity. Subjective noise sensitivity has fundamental relevance for people's reactions to noise, and females are more sensitive to noise than males (Senese et al., 2012).

Method

Participants

Eighty healthy hearing-normal adults (40 females; mean age=22.9 years, $SD=2.5$), including males and females matched for age and family socioeconomic status, $F_s < 1$, participated; none was a parent or worked with infants. The sample size was determined by a power analyses to ensure an adequate statistical validity (power $>.80$; Tabachnick & Fidell, 2012). The study was conducted in conformity with University Ethics Committee requirements and the Helsinki Declaration.

Materials and procedure

All participants completed a brief sociodemographic questionnaire, the Empathy Quotient, the Weinstein Noise Sensitivity Scale, and two auditory versions of the SC-IAT.

Sociodemographic questionnaire

The sociodemographic questionnaire collected participants' age, gender, working status, and level of education. The working status and level of education of participants' parents were used to compute the socioeconomic status of the family.

The Empathy Quotient (EQ)

The Italian short version of the EQ scale (Baron-Cohen & Wheelwright, 2004; Senese, De Nicola, Passaro, & Ruggiero, 2016) was administered. This 15-item self-report scale evaluates three different (but related) components of empathy: cognitive empathy, emotional reactivity, and social skills. Each item presents a statement, and respondents are asked to indicate their agreement on a 4-point scale, from *strongly disagree* to *strongly agree*. The short EQ yields also a composite total empathy score; higher scores indicate greater empathy ($\alpha=.78$).

The Weinstein Noise Sensitivity Scale (WNSS)

The Italian version of the WNSS (Senese et al., 2012) was administered to obtain a measure of sensitivity to noise. The WNSS is a 20-item self-report scale that evaluates affective reactions and attitudes to noise in general and to a variety of everyday environmental sounds. For each item, participants indicate their agreement on a 6-point scale, from *disagree strongly* to *agree strongly*. Higher scores indicate greater noise sensitivity ($\alpha=.89$).

Single Category Implicit Association Test (SC-IAT)

Following Karpinski and Steinman (2006), the SC-IAT paradigm was adapted to evaluate participants' implicit reactions to two target auditory stimuli (SC-IAT-A): infant cry and infant laugh. Each SC-IAT-A followed the original version of the paradigm. The SC-IAT-A is a two-stage measure; in each stage, words and sounds were presented auditorily, in random order, and preceded by a visual cue (an audio symbol). Participants were asked to classify the words or sounds into the correct category as quickly as possible by pressing one of two keys on a keyboard: "e" for left responses and "i" for right responses. In the first stage, positive words and target sounds were categorized with the same response key, and negative words with a different key (positive condition). In the second stage, negative words and target sounds were categorized with the same response key, and positive words with a different key (negative condition). Each stage consisted of 23 practice trials (3 filler trials plus one block of 20 trials) followed by 63 test trials (3 fillers trials plus three blocks of 20 trials each; see Table 1). For each block, the first three trials (one for each category) were filler and omitted from analysis because of their practice nature and typically lengthened latencies. Following the original version of the SC-IAT (see Karpinski & Steinman, 2006), to prevent a response bias or predictability of responses, target sounds, positive words, and negative words were presented in irregular frequencies across two conditions, one positive and one negative. In the positive condition, the frequency ratio was 6:6:8, respectively, for target sounds, positive words, and negative words, so that 60% of correct responses were on the left key and 40% of correct responses were on the right key. In the negative condition, the frequency ratio was 6:8:6, respectively, so that 40% of correct responses were on the left key and 60% of correct responses were on the right key. In each SC-IAT-A, one target sound (infant cry or infant laugh) was presented. The two SC-IAT were administered in a counterbalanced order, and the association between target sound and the attribute of the first classification phase was counterbalanced across stages and participants.

To oblige participants to be fast and accurate, a response window of 1500 ms was set for each trial. Participants were given feedback regarding the accuracy of each response. Correct

responses were followed by a green “O” in the centre of the screen for 150 ms; incorrect responses were followed by a red “X” in the centre of the screen for 150 ms. When participants failed to respond within the response window, a reminder to “Please respond more quickly!” appeared for 500 ms. For all blocks, the intertrial interval was 500 ms.

The IAT measure is derived by dividing the difference between the latencies of responses in the negative condition and the positive condition by the standard deviation of latencies of the two conditions (D-score; Greenwald, Nosek, & Banaji, 2003). If participants are faster in categorizing stimuli in the positive condition compared to the negative condition, their score is positive and they are considered to have a positive implicit attitude to the target stimuli. If participants are faster in categorizing stimuli in the negative condition compared to the positive condition, then their score is negative and they are considered to have a negative implicit attitude to the target stimuli. Because responses are scored using the D-score algorithm (Greenwald et al., 2003), values around 0 indicate the absence of a specific implicit attitude to target stimuli. Absolute values from 0.2 to 0.3 indicate a “slight” effect, values around 0.5 a “medium” effect, and values of about 0.8 to infinity a “large” effect. All the SC-IAT scores showed adequate reliability ($\alpha s > .70$).

In each SC-IAT-A, we used ten positive words (e.g., love, beautiful, luck, joy, etc.), ten negative words (e.g., bad, pain, negative, unpleasant, etc.), and six sound examples of each target category (cry and laugh). Words were distinguished as “positive” and “negative” and had to be classified into a positive or negative category, respectively. Words were chosen by means of a preliminary study because they were associated with infants or with crying. Sounds were examples of each target category, infant cry and infant laugh, and had to be classified as crying or laughing, respectively. Infant vocalizations were extracted from home videos. A research assistant, who was unaware of the purposes of the study, reviewed video records of the children to identify appropriate stimuli. An exclusion criterion was that the audio recording of infant vocalization contained background noise (e.g., adult talk, sounds from toys, or other environmental noise). Infant cries were extracted from home videos of unedited cry bouts of 10 firstborn 13-month-olds (5 girls/5 boys). Children were part of a longitudinal research project and did not present any cognitive concerns as confirmed by their Wechsler Preschool and Primary Scale of Intelligence-II scores at age 4 years. To be sure that cry stimuli were acoustically representative of the typical range, cry sounds were digitized and analysed using Praat acoustic analysis software (Boersma & Weenink, 2013). The duration of pauses (a silence longer than 250 ms within the episode of crying) in s was $M = 1.25$, $SD = 0.29$, and the number of utterances (expressed vocalization of distress between two pauses) was $M = 3.15$, $SD = 1.33$. Infant positive vocalizations (laughter) were extracted from home videos of unedited laughter bouts of the same infants age (13-month-olds) from which the cries were extracted. The duration of pauses (a silence longer than 250 ms within the episode of laughter) in s was $M = 1.38$, $SD = 0.50$, and the number of utterances (expressed positive vocalization between two pauses) was $M = 3.63$, $SD = 0.91$. To optimize and equate for sound quality and volume, and to ensure that the stimuli were representative of the typical range of infant vocalizations, the first 5 s of infant vocalizations were used. All stimuli were normalized for intensity, and the volume was kept constant for all the presentations for all the participants. The average fundamental frequencies of cries and laughs were 363.07 Hz ($SD = 35.82$) and 361.88 Hz ($SD = 43.34$), respectively,

$t(10)=0.052$, $p=.959$, and the average peak amplitudes of the infant cries was 73.98 dB ($SD=2.20$) and laughs was 71.68 dB ($SD=2.07$), $t(10)=1.87$, $p=.091$. Acoustic stimuli were presented binaurally through Sennheiser HD 419 headphones.

Results

Preliminary descriptive analyses were executed to investigate missing values, variable distributions, and univariate normality (Tabachnick & Fidell, 2012). D-scores were analysed by means of a generalized linear model that treated infant cue (cry vs. laugh) as a 2-level within-subjects factor, gender (males vs. females) as a 2-level between-subjects factor, and empathy as covariate. Bonferroni correction was used to analyse post hoc effects of significant factors, the regression coefficients were used to analyse the effect of the covariate on the dependent variable, and partial eta squared (η^2_p) was used to evaluate the magnitude of significant effects. Because females reported greater sensitivity to noise than males on the WNSS, $F(1,78) = 11.95$, $MSE = 0.42$, $p < .001$, to test if effects were influenced by individual sensitivity to noise, we replicated the analyses adding the WNSS score as covariate.

D-scores differed by cue condition, $F(1,77) = 9.04$, $MSE = 0.08$, $p = .004$, $\eta^2_p = .110$, and by the interaction Cue×Empathy, $F(1,77) = 5.65$, $MSE = 0.08$, $p = .020$, $\eta^2_p = .072$. The post hoc analyses for the cue main effect revealed that the mean D-score associated with infant cry, $M = -0.05$, 95%CI $[-0.13, -0.02]$, was negative and different from the mean D-score associated with infant laugh, which was positive, $M = 0.11$, 95%CI $[0.04, 0.18]$. The parameter analyses of the Cue×Empathy effect revealed that, independent of gender, participant empathy moderated reactions to infant stimuli. Empathy was related only to implicit reactions to infant laugh, $b = -0.36$, $p = .022$, 95%CI $[-0.66, -0.05]$, $\eta^2_p = .070$, not to infant cry. The lower participants' empathy, the more positive their implicit association to infant laugh.

The model that considered WNSS as covariate confirmed only the Cue×Empathy effect, $F(1,76) = 7.53$, $MSE = 0.08$, $p = .008$, $\eta^2_p = .095$, and showed that sensitivity to noise moderated the implicit reaction to infant cue, $F(1,76) = 3.97$, $MSE = 0.08$, $p = .049$, $\eta^2_p = .052$. The parameter analyses of the Cue×WNSS effect revealed that, independent of gender and empathy, participant noise sensitivity was related only to implicit reactions to infant cry, $b = -0.15$, $p = .013$, 95%CI $[-0.27, -0.03]$, $\eta^2_p = .083$, not to infant laugh. The higher participants' noise sensitivity, the less positive their implicit association to infant cry.

Discussion

The main aim of the present study was to investigate the valence of adult implicit representations of infant cries and laughs by adopting a paradigm that circumvents deliberative processes and reduces the impact of social desirability bias. To this end, we adapted the SC-IAT paradigm into an auditory version to evaluate implicit reactions of young adults to infant cries and laughs, to investigate if their reactions were moderated by gender and empathy, and to evaluate whether individual noise sensitivity moderates implicit reactions. To our knowledge, this is the first study to evaluate the valence of adults' implicit

associations to infant auditory cues and to investigate gender differences in adults' reactions controlling for subjective noise sensitivity.

We found that adults' implicit associations were modulated by specific auditory cues produced by infants. In accord with our hypothesis, adults showed a positive implicit reaction to infant laugh, and a negative implicit association to infant cry; in neither case, however, did they exhibit extreme valence. Moreover, our data confirmed the expectation that empathy moderates adults' associations to infant cues; the significant difference between adults' implicit associations to infant cry and infant laugh was observed only for adults low in empathy. Participants high in empathy generally showed no specific association to infant cues. As regards expected gender differences, our results showed no significant differences between males and females when controlling for their empathy scores and noise sensitivity.

Cries and laughs are critical and salient auditory stimuli because they constitute a primary means of communication for young infants (Zeifman, 2001). The results of this study confirm that adults show specific reactions to each cue and that the SC-IAT-A can be used to evaluate the valence of adults' implicit associations. That the valence of implicit associations to infant cry was not extreme supports the idea that infant cry is not associated with a strong emotionally negative polarity, because it should function to trigger caregiving (Zeifman, 2001) rather than, say, maltreatment or avoidance (Dix, 1991). At the same time, however, we observed individual differences in reactions to infant cry, with some participants showing strong negative associations (i.e., D-score < -.50). The clinical relevance of these individual differences should be explored in future research.

Investigating adults' implicit reactions to infant cues is important for several reasons. For example, adults' reactions to infant cues are predictive of diverse child outcomes (Leerkes et al., 2011; McElwain & Booth-LaForce, 2006). This study presents the first evidence that an auditory version of the SC-IAT can be used to evaluate adults' implicit reactions to infant vocalizing. Similar to Senese et al. (2013), we found individual variation in adults' implicit dispositions to cues produced by infants. Adults' implicit reactions could help to explicate individual variation in the quality of adult-child interactions. This consideration assumes that the implicit response can be considered a valid and specific predictor of adult-child behaviour. Several studies have shown that implicit associations are predictive over and above explicit evaluations, if only with small—to—moderate effect sizes (Greenwald, Banaji, & Nosek, 2015), and Senese et al. (2013) found a significant association between adults' implicit attitude toward infant faces and their expressed desire to interact socially with infants. Implicit associations might be related to child-related behaviours, particularly when individuals are under stress (e.g., when the child is crying; see also Frieze, Hofmann, & Schmitt, 2008), and this effect, even if small, might be relevant when “cumulating over repeated occurrences to the same person” Greenwald et al. (2015, p. 558). In other words, the valence of the implicit association to infant cues could reflect biologically rooted or subcortical reactions to infant cues (see Senese et al., 2013; Swain et al., 2014). Future studies might implement the SC-IAT-A paradigm to replicate these results and to determine whether implicit associations to infant auditory cues are related to the quality of infant-care

practices (Kadushin & Martin, 1981) or longitudinally to child outcomes (Leerkes et al., 2011; McElwain & Booth-LaForce, 2006).

Our results with respect to empathy moderation showed that adults who are high in empathy display only muted reactivity to infant cues. This finding seems to indicate that, when exposed to distressing infant cues, adults who are low in empathy react in more negative or less sensitive ways perhaps because they are less able to regulate their arousal (see Dix, 1991).

With respect to gender differences, the results failed to confirm our expectations. However, this is the first time that the SC-IAT paradigm has been used to evaluate implicit reactions to infant auditory cues, and in previous studies the valence of reactions to infant cues was evaluated by self-reports. Our result contrasts with studies that used fMRI and self-reports and found gender differences in responses to infant cry (de Pisapia et al., 2013; Seifritz et al. 2003), but accords with research that evaluated the adults' autonomic arousal (Boukydis & Burgess, 1982; Frodi et al. 1978). It could be that our measure evaluates implicit "immediate affective reactions" (Gawronski, Hofmann, & Wilbur, 2006, p. 494), and gender differences in reactions to infant cry only emerge for more conscious or controlled thoughts and beliefs. If confirmed, this result would suggest that the observed gender differences are related more to cultural than biological factors.

We also found, for the first time, that adult reactions to infant cry are related to noise sensitivity. We have no specific explanation for why noise sensitivity might be related to the implicit association to infant cry only and not also to infant laugh. It could be that the negative valence of the infant cry determines this effect. Previous studies have shown that subjective noise sensitivity indicates annoyance and that females have greater sensitivity to noise than males (Senese et al., 2012). Future studies should take this factor into account to disentangle the extents to which gender differences or differential noise sensitivity reflect reactions to infant auditory cues.

Despite of the several merits of this research, including the first application of the single category implicit association paradigm to infant auditory cues, direct evaluation of the valence of emotional reactions to infant cries and laughs, and investigation of gender differences controlling for individual noise sensitivity, several limitations of the work should be noted. The sample size was relatively small, but still sufficient to ensure adequate statistical validity and power. We recruited a sample of non-parent young adults to control for parenthood experience, but future work should include parents with varying amounts of experience, those who are more and less sensitive to infant cues, and other groups, such as parents of infants at-risk. We also studied males and females, but mothers and fathers and non-parental caregivers should be included.

Studying adult reactions to infant cues is valuable to better understand processes that regulate infant-adult caregiving interactions. Here, we adapted the SC-IAT paradigm to evaluate the implicit valence of auditory infant cues, and we found specific reactions to infant cries and laughs. The paradigm introduced here offers a reliable and valid means to evaluate the valence of reactive impulses associated with auditory infant cues, and in

conjunction with the other methodologies, it could provide fresh insights to understanding the parental brain and processes that regulate the quality of infant caregiving.

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Table 1
Schematic description of the Auditory Single Category Implicit Association Test (SC-IAT-A)

Block	Trials	Function	Condition	Left-key response	Right-key response
1	23	Practice	Positive	Positive words + target sound	Negative words
2	63	Test	Positive	Positive words + target sound	Negative words
3	23	Practice	Negative	Positive words	Negative words + target sound
4	63	Test	Negative	Positive words	Negative words + target sound

Note. The SC-IAT-A procedure involved a series of four classification tasks. Blocks 1-2 and 3-4 were experienced as one continuous block. At the beginning of each block, categories were assigned to a left or right key press response. Within each block, different auditory stimuli were presented randomly. The attribute dimensions were fixed, whereas the target sounds were reversed across the two conditions.