

Negative Relations Between Pacifier Use and Emotional Competence

Paula M. Niedenthal

University of Wisconsin–Madison

Maria Augustinova, Magdalena Rychlowska, and Sylvie Droit-Volet

Clermont Université

Leah Zinner

Oglethorpe University

Ariel Knafo

The Hebrew University of Jerusalem

Markus Brauer

University of Wisconsin–Madison

Research in psychology and neuroscience suggests that facial mimicry plays a causal role in understanding facial expression of emotion. Accurate understanding of facial emotion, in turn, grounds emotional development. Are pacifiers, which disrupt facial mimicry in the user, associated with compromised emotional development? We examined facial mimicry in children and found that duration of pacifier use was associated with reduced facial mimicry in boys. In two questionnaire studies of young adults, pacifier use also predicted lower perspective taking and emotional intelligence in males. Pacifier use did not predict these emotion processing skills in girls. Future confirmatory studies are proposed.

Pacifier use by infants and children is undeniably controversial, as attested to by medical and parenting literature. For example, the World Health Organization recommends limiting the use of pacifiers (Marter & Agruss, 2007), partly to promote successful breast-feeding (World Health Organization/United Nations Children's Fund, 1989) and partly because of a positive relation between pacifier use and incidence of middle ear infections and dental abnormalities (Howard et al., 2003; Rovers et al., 2008). In contrast, the American Academy of Pediatrics recommends pacifier use during sleep in the 1st year of life as a preventive measure

against SIDS (Hauck, Omojokun, & Siadaty, 2005; Mitchell, Blair, & L'Hoir, 2006).

Advances in psychology and neuroscience suggest that an evaluation of the possible emotional consequences of pacifier use is now warranted (Niedenthal, 2007). Specifically, facial muscles have been implicated in the comprehension of emotional information such as facial expressions of emotion (Mojzisch et al., 2006). Automatic facial mimicry appears to be positively related to the ability to perceive subtle changes in interaction partners' facial expressions (Niedenthal, Brauer, Halberstadt, & Innes-Ker, 2001) and to the speed and accuracy of classifying such expressions (Maringer, Krumhuber, Fischer, & Niedenthal, 2011; Stel & Van Knippenberg, 2008). Individuals showing stronger

Correspondence should be sent to Paula M. Niedenthal, Department of Psychology, University of Wisconsin–Madison, 1202 West Johnson Street, Madison, WI 53706. E-mail: niedenthal@wisc.edu

automatic facial mimicry also tend to have higher levels of empathy (Sonnby-Borgström, 2002). Conversely, the reduction of mimicry, as produced for example by Botulinum toxin (Botox) injections, compromises emotional responding to facial expressions of emotion as well as the ability to accurately read facial expressions (Hennenlotter et al., 2005; Neal & Chartrand, 2011). Preverbal infants are reliant on the accurate reading of facial expression for adaptive learning, and thus they may be at risk if facial mimicry is systematically inhibited. Note that we use the term “mimicry” rather than “imitation.” This is done in order to distinguish the present phenomenon from the construct of intentional matching of behavior or the goal of producing a similar outcome (see Want & Harris, 2002).

The potential problem with pacifiers is that in occupying the muscles around the mouth they may systematically disrupt the user’s facial mimicry, just as typical methods for blocking mimicry in the laboratory have been shown to do (Niedenthal et al., 2001; Oberman, Winkielman, & Ramachandran, 2007). Over time, pacifier users may show less mimicry of perceived facial expressions because this response has been repeatedly restricted. If consistent pacifier use has an inhibiting influence on facial mimicry, and because the processing of facial expression plays an important role in emotional development (Campos, Thein, & Owen, 2003), pacifier use could therefore have deleterious, long-term emotional effects. Any such effects would be further aggravated because the pacifier also blocks a caretaker’s perception and mirroring of the expressed emotions of the pacifier user. Note that this account assumes detrimental effects of pacifier use during the day, especially when the caretaker is present, and not during sleep when mimicry is not an issue.

A behavior conceptually related to pacifier use is thumb sucking. In the present research we examined thumb sucking as well as pacifier use, but we did not predict that the two behaviors would, in practice, have the same effects on emotional competences. Our differential predictions were based on the logic that, first, thumb sucking is viewed as a more negative (“dirty”) habit and therefore may be used more privately than pacifiers, and second, the child controls thumb sucking, whereas the introduction and the early use of pacifiers is typically controlled by caretakers. It may be that caretakers’ decisions to invite pacifier use come at times that have negative consequences for emotional development. For example, caretakers might propose pacifier use at exactly the moments when the child typically practices facial mimicry or invites affective resonance with the mother. Given that little or no previous research on this topic has been conducted, these hypotheses were exploratory in nature.

The existing literature on sex differences in emotional development suggests that sex could be a moderator

variable, such that pacifier use may be less detrimental for girls than for boys. Girls’ emotional development emerges more rapidly and they engage in behaviors that involve the solicitation of and resonance with the facially expressed emotions of others at an earlier age. Compared to boys, girls engage earlier in behaviors related to the use of eye contact, facial expression, and facial mimicry to guide behavior (Brody, 2000). By 6 months, girls initiate more social interaction with the mother by looking and smiling at her, compared to boys (Gunnar & Donahue, 1980), and girls reference caretakers’ facial expressions more often as well (Rosen, Adamson, & Bakeman, 1992). For example, at 8 months, when confronted with a novel toy, girls were more likely than boys to consult an experimenter’s face (Sigman & Kasari, 1994). Another study found that when an experimenter appeared to hurt himself, 12-month-old girls displayed more empathy and distress than boys (Zahn Waxler, Radke-Yarrow, Wagner, & Chapman, 1992). These and related findings suggest that compared to girls, boys may be more vulnerable to the consequences of inhibition of channels for processing emotional information. Any differential vulnerability of the sexes may also be exaggerated by the fact that caretakers discuss emotions more and with greater precision to daughters than sons, suggesting that girls receive more multimodal emotional input than boys over the course of emotional development (Adams, Kuebli, Boyle, & Fivush, 1995; Fivush, Brotman, Buckner, & Goodman, 2000).

We conducted three studies to test the relationship between pacifier use and indicators of competence in emotional information processing, with an anticipation of moderation by sex. The first study tested the hypothesis that pacifier use is associated with reduced spontaneous mimicry of perceived facial expressions. First- and second-grade children saw human faces presented on the computer. The faces expressed different dynamic emotional expressions, and the children’s own faces were filmed for later coding of correspondent facial mimicry. We expected that more frequent pacifier use, and specifically daytime use, would be negatively related to spontaneous facial mimicry, perhaps especially in boys.

STUDY 1

Method

Participants. First- and second-grade teachers at four elementary schools in the Auvergne region of France aided in recruiting pupils. They corresponded with parents by placing into all pupils’ notebooks a questionnaire and a form that authorized the child to participate and to be filmed. Only one child was not authorized to

participate in the study. Participants were 106 children (61 boys, 45 girls) whose average age was 7 years 3 months ($SD=14$ months). Forty-seven participants (47% female) had used a pacifier, and among pacifier users the average length of use was 37 months ($SD=18$ months).

Materials and procedure. As part of the recruitment procedure, participants' parents completed a questionnaire assessing the duration of their child's pacifier use and thumb sucking (if any). Specifically, parents noted in months the age of onset and the age of offset of both practices. Parents also indicated the frequency with which their child used a pacifier (a) during the day at home, (b) at night, and (c) during the day outside of the home, including daycare, and the frequency with which their child sucked his or her thumb (a) during the day at home, (b) at night, and (c) during the day outside of the home, including daycare. Participants responded on a 4-point scale from 0 (*never*) to 3 (*usually*). Finally, the questionnaire assessed demographics that could serve as common cause variables, which explain both pacifier use and frequency of facial mimicry. These included mother and father's education, family size, birth order, and age at entrance into daycare or school.

Children were removed individually from their classrooms and were accompanied by an experimenter to an empty room equipped with a laptop computer where they performed a "morphing" task (Fraley, Niedenthal, Marks, Brumbaugh, & Vicary, 2006). Although this task was not specifically developed for use with children, when presented with the morph movies, children will mimic the faces. Thus, the task constituted a useful tool for observing differences in facial mimicry.

The experimenter explained that the child would see films of faces presented on a computer. He or she further explained that the face would express an emotion, such as happiness or sadness, which would start to change, and would slowly turn into another expression. Each stimulus (morph movie) contained a smile and a sad expression in one of two orders. When the child thought that the initial smile (or sad expression) was no longer present on the face (i.e., it had turned into the second expression), they were to press a button to stop the film. After two practice trials, children saw 14 different faces (eight male, six female), each of which expressed a smile that became sad and a sad expression that turned into a smile, for a total of 28 trials. The children's faces were filmed with a Sony DCR-HC51 digital video camera while they viewed the morph movies.

Two coders who were naïve to pacifier status and film type viewed the video recording of all trials of every

participant. They independently noted the presence of a smile and a sad expression on each trial. Only smiles and sad expressions that occurred during the morph film (demarcated by auditory tones) and directed at the film itself (and not at another object such as the experimenter) were counted. Disagreements of classification were resolved by discussion. Each participant therefore received two mimicry scores representing the total number of mimicked smiles and of sad expressions on 28 trials. Number of smile mimics varied from 0 to 17 ($M=4.00$, $SD=4.5$), and number of sad expression mimics varied from 0 to 15 ($M=3.1$, $SD=3.90$). Values of three or more standard deviations above and below the mean were transformed into missing values, leading to the exclusion of 3.8% of the data.

Results

We estimated a multivariate regression model with mimicry as the dependent variable, type of expression (smile vs. sad) as a within-subjects independent variable, and sex (coded -1 and $+1$), length of pacifier use (in mean deviation form; nonpacifier users received a score of 0 on this measure), the product of sex and length of pacifier use, mother's education and length of child's thumb sucking as between-subjects independent variables. No other control variables were related to the dependent variables, so these were not included in the model.

The main effects of sex and length of pacifier use were not significant ($ps > .18$). There was, however, a significant interaction between sex and length of pacifier use, $F(1, 84)=6.07$, $p=.02$, $\eta^2=.07$. Post hoc analyses revealed that there was an effect of length of pacifier use for boys ($\beta=-.39$), $F(1, 84)=7.23$, $p=.009$, $\eta^2=.08$, but not for girls ($\beta=.10$), $F(1,84)=0.44$, $p=.51$ (see Figure 1). There was no three-way interaction between sex, length of pacifier use, and type of expression, $F(1, 84)=0.00$, $p=.98$. The effect of mother's education was significant, $F(1, 84)=6.57$, $p=.01$, $\eta^2=.07$, as was the effect of thumb sucking, $F(1, 84)=4.29$, $p=.04$, $\eta^2=.05$, such that higher levels of both were related to higher levels of mimicry.

If mimicry is affected by pacifier use, then pacifier use at the times of the day when emotional learning through facial mimicry of caretakers occurs should be most detrimental to the developing child. In contrast, pacifiers should have a lesser effect on facial mimicry if children use them only at night while sleeping, or even during the day outside of home (i.e., when they do not interact with their primary caregiver and may use the pacifier to remain quiet in a group setting, for instance, while listening to a story).

We estimated three multivariate regression models in which we included only pacifier users. In all three

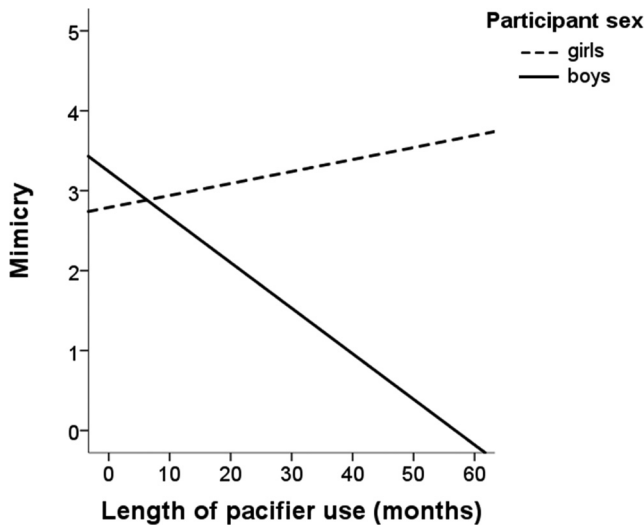


FIGURE 1 Mimicry as a function of participant gender and length of pacifier use in Study 1. *Note.* The lines represent predicted values that were estimated at the mean of the covariates.

models the dependent variable was mimicry, the within-subjects independent variable was type of expression (happy vs. sad), and the between-subjects independent variables were sex (coded -1 and $+1$), frequency of pacifier use (in mean deviation form), the product of sex and frequency of pacifier use, mother's education, and frequency of child's thumb sucking. In the first analysis, the independent variables included the frequency of pacifier use (and of thumb sucking) during the day at home, in the second pacifier use (and thumb sucking) at night, and in the third pacifier use (and thumb sucking) during the day outside of home.

The first analysis yielded two nonsignificant main effects of sex and frequency of pacifier use during the day at home ($ps > .17$). The predicted interaction between the two variables was statistically significant, however, $F(1, 34) = 4.57$, $p < .04$, $\eta^2 = .12$. The bivariate correlation between mimicry (averaged across both expressions) and frequency of pacifier use during the day at home was $r = .20$, ns , for girls and $r = -.51$, $p = .01$, for boys. In the second and third analyses, neither the main effects of sex or frequency of pacifier use nor the interactions between the two variables were statistically significant ($ps > .10$). These results are consistent with the interpretation that frequency of pacifier use is related to less facial mimicry primarily when children use the pacifier during the day at home, that is, when they are interacting with their primary caregiver.

STUDY 2

The results of Study 1 suggest that longer pacifier use in boys is related to less facial mimicry in a task that

typically elicits such mimicry. If facial mimicry is important for accuracy in the processing of facial expression, as past literature suggests, then we might expect young adults who have used pacifiers to show deficits in emotional responses that are reliant on reproducing the emotional state of the perceived individual in the self. For instance, pacifier use could be related to the development of components of empathy that involve the ability to imagine the situation of the other. We tested this by examining the relationship between pacifier use and the perspective-taking component of empathy in young adults. University students completed questionnaire measures of pacifier use, thumb sucking, and empathy.

Method

Participants. One hundred sixty-seven American university students in the Midwest and South (78% female) were recruited in exchange for course extra credit (if enrolled in a psychology class) or \$10. The average age was 19 years 4 months ($SD = 15$ months). Of these participants, 92 (82% female) had used a pacifier at some point during their childhood for an average length of 22 months ($SD = 15$ months).

Materials and procedure. Participants received a packet of questionnaires in class, in laboratory groups, or in other university group settings. They were instructed to complete the questionnaire in private and to return it to the experimenter. The packet contained a measure of pacifier use and thumb sucking similar to that completed by parents in Study 1 but worded from the perspective of the participant. The packet also contained the Davis Interpersonal Reactivity Index (IRI; Davis, 1983). The IRI was developed using a multidimensional approach and was designed to evaluate several components of empathy on a scale from 1 (*does not describe me very well*) to 5 (*describes me very well*). The perspective taking (PT) subscale assesses the ability to experience events from the viewpoint of others. A sample item is "I try to look at everybody's side of a disagreement before I make a decision." This is the skill that we thought would be most affected by reduction of mimicry due to pacifier use, given that mimicry involves putting oneself in structural, embodied alignment with the observed target person (Decety & Grezes, 2006). Thus, the PT subscale served as the main dependent variable.

Last, the packet included the Adult Attachment Questionnaire (Simpson, Rholes, & Phillips, 1996). The Adult Attachment Questionnaire assesses avoidant and ambivalent attachment as continuous variables, on a scale from 1 (*I strongly disagree*) to 7 (*I strongly agree*).

A sample item from the Ambivalent Attachment subscale is "Others often are reluctant to get as close as I would like." We wanted to be able to control for ambivalent attachment because it could serve as a common cause variable.

Results

After reverse-coding the appropriate items, we averaged the items of the PT subscale of the IRI. We conducted a 2×2 ANCOVA with PT as the dependent variable, sex, and pacifier use (yes/no) as between-subjects independent variables, and mother's education and child's thumb sucking (yes/no) as covariates. The main effect for sex was significant, $F(1, 158) = 4.03, p = .05, \eta^2 = .03$, but was qualified by a significant Sex \times Pacifier Use interaction, $F(1, 158) = 4.66, p = .03, \eta^2 = .03$. Post hoc analyses revealed that pacifier use was associated with lower levels of perspective taking for boys, $F(1, 158) = 4.27, p = .05, \eta^2 = .03$, but not for girls, $F(1, 158) = 0.44, p = .51$ (see Figure 2). The effect of mother's education and child's thumb sucking were not statistically significant ($ps > .39$). The inclusion of ambivalent attachment as a covariate did not affect any of the results.

We also performed similar analyses using the length of pacifier use (in months) as a continuous independent variable. Although the hypothesized Sex \times Length of Pacifier Use interaction did not reach conventional levels of significance, $F(1, 112) = 1.99, p = .16, \eta^2 = .02$, the pattern was identical to the mimicry result observed in Study 1. We attribute the nonsignificance to low power (i.e., insufficient number of male respondents) and measurement error. The latter was suggested by

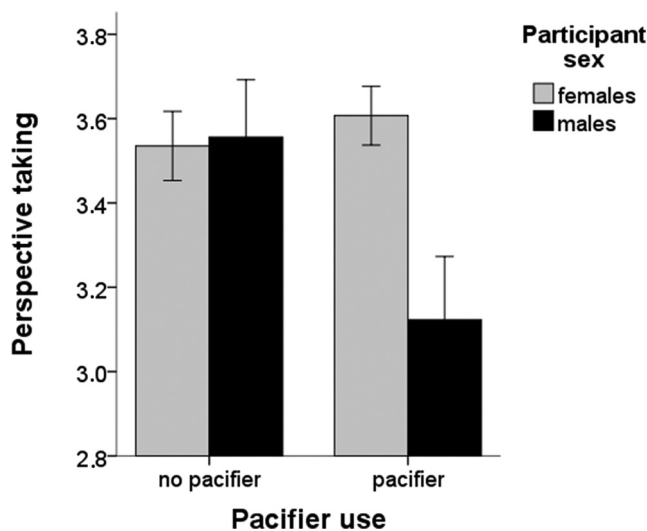


FIGURE 2 Perspective taking as a function of participant sex and pacifier use (coded yes/no) in Study 2.

the fact that some respondents wrote on the questionnaire that they did not know how long they had used a pacifier, and thus their estimate of the length of pacifier use was approximate at best.

STUDY 3

A final study examined the hypothesis that pacifier use is predictive of lower emotional intelligence in young adults. As in Study 2, university students completed questionnaire measures of pacifier use and thumb sucking, and emotional intelligence. We again measured possible third variables that could be causal of both pacifier use and emotional competence for use in statistical analyses.

Method

Participants. One hundred twenty-four American university students (77% female) from the Midwest and South (average age $M = 20$ years 9 months, $SD = 17$ months) and 304 students (79% female) from a university in central France (average age $M = 20$ years 6 months, $SD = 21$ months) participated in the study ($N = 428$). The French students were on average 3 months younger than the American students, $t(419) = 1.68, p = .10$. American university students were recruited in exchange for course extra credit (if enrolled in a psychology class) or \$10. French university students were recruited through an announcement made in large introductory classes to a variety of majors. There were no hypotheses regarding nationality. Two samples were obtained only to increase the power of the study given the moderation by sex observed in the previous two studies and to increase external validity.

Materials and procedure. The packet of questionnaires used in Study 3 contained the same measures of pacifier use, thumb sucking, and attachment as used in Study 2. It also included a measure of emotional intelligence, the Adolescent Short Form of Trait Emotional Intelligence Questionnaire (TEIQue-ASF; Mikolajczak, Luminet, Leroy, & Roy, 2007; Petrides, Sangareau, Furnham, Frederickson, 2006). The TEIQue-ASF consists of 30 items answered on a Likert-type scale from 1 (*I strongly disagree*) to 7 (*I strongly agree*). A sample item is "I'm able to cope well in new environments." Higher scores indicate greater global trait emotional intelligence. To assess participants' dispositional (trait) anxiety, we included the Trait Anxiety subscale of State-Trait Anxiety Inventory (STAI-Y; Gauthier & Bouchard, 1993; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). The STAI-Y consists of 20 items

answered on 4-point Likert-type scale from 0 (*almost never*) to 3 (*very often*). A sample item is “I feel nervous and restless.” Higher scores indicate greater trait anxiety. We measured trait anxiety because it is only moderately correlated with attachment ambivalence (e.g., $r = .26$ in this study) and could serve as a common causal variable in the present context.

To increase accuracy of reporting, participants were encouraged to contact their parents in order to confirm length of pacifier use and to check a box on the questionnaire if they had done so. About 75% of the sample reported having contacted their parents.

Results

After reverse-coding the appropriate items, we averaged the items of the Emotional Intelligence scale and of the Trait Anxiety scale. For each participant we computed two scores: the duration (in months) of both pacifier use and thumb sucking.

We first conducted a 2×2 analysis of covariance with emotional intelligence as the dependent variable, sex, and pacifier use (yes/no) as between-subjects independent variables, and mother's education, trait anxiety, nationality, and thumb sucking (yes/no) as covariates. The main effect of sex was marginally significant, $F(1, 409) = 2.82$, $p = .09$, $\eta^2 = .01$, whereas the main effect for pacifier use did not reach conventional levels of significance, $F(1, 409) = 1.73$, $p = .19$. However, again there was a reliable Sex \times Pacifier Use interaction, $F(1, 409) = 7.24$, $p = .007$, $\eta^2 = .02$. Post hoc analyses revealed that pacifier use was associated with lower levels of emotional intelligence for boys, $F(1, 409) = 4.31$, $p = .04$, $\eta^2 = .01$, but not for girls, $F(1, 409) = 0.87$, $p = .35$. Mother's education, $F(1, 409) = 0.55$, $p = .46$, and child's thumb sucking, $F(1, 409) = 0.65$, $p = .42$, were not significant covariates. As expected, the effect of trait anxiety was highly significant, $F(1, 409) = 452.76$, $p < .0001$, $\eta^2 = .53$. Additional analyses showed that the three-way interaction between sex, pacifier use, and nationality was nonsignificant, $F(1, 406) = 0.04$, $p = .85$, suggesting that the detrimental effect of pacifier use for boys is not country specific. The inclusion of ambivalent attachment as a covariate did not affect any of the results.

We also conducted similar analyses using duration of pacifier use as the independent variable. The main effect of sex was not significant, $F(1, 390) = 1.70$, $p = .19$, whereas length of pacifier use was marginally significant, $F(1, 390) = 3.23$, $p = .07$, $\eta^2 = .01$. The hypothesized Sex \times Length of Pacifier Use interaction was significant, $F(1, 390) = 4.12$, $p = .04$, $\eta^2 = .01$. Post hoc analyses revealed that longer pacifier use was associated with lower emotional intelligence for boys ($\beta = -.14$), $F(1, 390) = 4.66$, $p < .04$, $\eta^2 = .01$, but not for girls ($\beta = .01$),

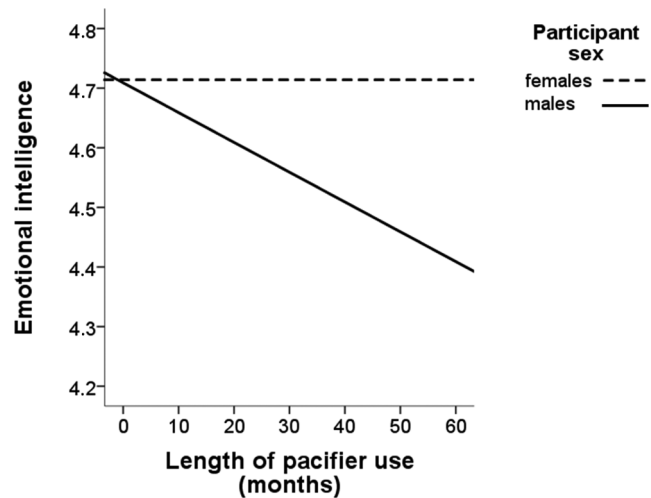


FIGURE 3 Emotional intelligence as a function of participant sex and length of pacifier use in Study 3. *Note.* The lines represent predicted values that were estimated at the mean of the covariates.

$F(1, 390) = 0.02$, $p = .88$ (see Figure 3). Once again, effects of mother's education and length of child's thumb sucking were not significant ($ps > .39$), whereas the effect for trait anxiety was $F(1, 390) = 426.84$, $p < .0001$, $\eta^2 = .52$.

There were no interactions with nationality in either of the analyses. In addition, the effects did not change if the participants who had not contacted their parents to confirm pacifier use and duration were excluded from the sample.

GENERAL DISCUSSION

The results of these three studies reveal a negative association between pacifier use and emotional competences in boys. The studies do not allow us to draw causal conclusions, as the children were not randomly assigned to pacifier use. Nonetheless, our measurement of potential common cause variables did include demographic (e.g., mother's education) and personality (e.g., anxiety) indicators that summarize well the child's environment and temperament. None of these explained both pacifier use and emotional competences. The fact that the effect of pacifier use was greater with longer duration of use is consistent with a causality interpretation that should be tested in follow-up research. Finally, as shown in the first study, the detrimental effects of pacifier use were best explained by the frequency of use during the day rather than at night (during sleep) when facial mimicry does not occur. This finding is also consistent with a causal account.

Thumb sucking was compared to pacifier use in each study. In no case did thumb sucking have the same effect or explain the same variance. Indeed, in Study 1 thumb

sucking was seen to be positively, not negatively, associated with facial mimicry. Findings of Study 2 and 3 did not show long-term effects of thumb sucking on emotional competence, but future studies should continue to explore the implications of the findings in Study 1.

Only boys showed compromised interpersonal emotional functioning (mimicry, perspective taking, and emotional intelligence) as a function of pacifier use. This is consistent with the existing literature on sex differences in emotional expression and emotional socialization. In particular, the literature on emotional expressiveness in girls and boys indicates that boys are more vulnerable than girls to disruptions of emotional information processing early in development, both because they are more immature in this area and because compensation by parents in other modalities may not occur. Still, future research needs to address questions of a critical period for harmful effects of pacifier use and of a dose–response relationship. Just how much pacifier use is actually problematic for emotional development?

Perceptions of pacifier users may also contribute to sex differences in the effects of pacifier use. Specifically, another study from our laboratory showed that adults perceived 3-year-old girls and boys with pacifiers in their mouths to be significantly less emotionally skilled and developed compared to the same girls and boys without pacifiers in their mouths (Niedenthal et al., 2012). There was no effect of sex on perception of pacifier users: Female pacifier users were perceived to be as emotionally unskilled as boys in the study. This finding may help to illuminate the present pattern of findings. In particular, social norms dictate that girls *should* be emotional and expressive “experts” (Fischer, 2000). The fact that girls are generally expected to be emotionally skilled, combined with the fact that girls using pacifiers are judged as low on such skills, may motivate compensation by caretakers. That is, caretakers might work hard to stimulate girl pacifier users—harder even than nonpacifier-using girls—thereby compensating for possible emergent developmental differences between these two groups. In contrast, the perception of lower emotional expertise in boy pacifier users, consistent as it is with social norms (Fischer, 2000), may be less likely to motivate increases in emotional stimulation in other response modalities by caretakers. Thus, although caretakers of girls may compensate for the deleterious effects of pacifier use, caretakers of boys may not, and this could leave boys more vulnerable to the consequences of disrupted facial mimicry.

The moderation by sex of the pacifier and emotional competence relationship observed in all three of the present studies speaks to the nagging possibility of reverse causality. That is, despite the specific findings detailed at the beginning of this section, all of which

are consistent with the causality interpretation favored here, we cannot rule out with certainty the possibility that children with emotional problems are more likely to be given pacifiers and to show poor performance on indicators of emotional information processing. However, it is also hard to imagine why the reverse causality interpretation would not be equally true for both girls and boys. It would seem that if emotional regulation problems cause the introduction of pacifiers, then both boys and girls with emotion regulation problems would be given pacifiers and also show later disturbances in emotional information processing.

Our studies show a relationship between pacifier use and facial mimicry in children, as well as between pacifier use and emotional processing competences in young adults. However, the studies do not allow for a direct test of mediation. Thus, it cannot be claimed that the effect of pacifier use on compromised emotional competences in adolescence is mediated by inhibited facial mimicry in infancy. Longitudinal and other confirmatory studies that can both test a possible causal role of pacifier use in emotional competence and further evaluate any mechanistic role of facial mimicry in this causal link will need to be undertaken.

Future studies should also test the possibility that any stable negative impact of the pacifier may in part be due to effects of pacifiers on perceivers in the social environment. Recent findings suggest that perceivers mimic some expressions displayed by infants with a pacifier (i.e., an expression covered by a pacifier) significantly less than they mimic expressions of infants without pacifiers (Niedenthal et al., 2012). This suggests that pacifiers can inhibit the emotional expressiveness of the pacifier user’s social environment in addition to the emotional expressiveness of the pacifier user himself or herself.

In conclusion, the present data suggest that pacifiers may inhibit some aspects of emotional development that rely on facial mimicry and its role in processing incoming emotional information. A rich network of muscles in the face is used to produce expressions of emotion. As research accumulates supporting embodied simulation theories of emotional information processing (Niedenthal, 2007), questions about the consequences of inhibiting the body’s emotion representational systems, such as the muscles of the face, will become more urgent. We see this set of studies as a first attempt to address the negative consequences of such inhibition early in development when emotional skills are being set in place.

REFERENCES

- Adams, S., Kuebli, J., Boyle, P., & Fivush, R. (1995). Gender differences in parent-child conversations about past emotions: A longitudinal investigation. *Sex Roles, 33*, 309–323.

- Brody, L. R. (2000). The socialization of emotion: Display rules, infant temperament, and differentiation. In A. Fischer (Ed.), *Gender and emotion* (pp. 24–47). Cambridge, England: Cambridge University Press.
- Campos, J., Thein, S., & Owen, D. (2003). A Darwinian legacy to understanding human infancy. *Annual NY Academy of Science*, 1000, 110–134.
- Davis, M. H. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology*, 44, 113–126.
- Decety, J., & Grezes, J. (2006). The power of simulation: Imagining one's own and other's behavior. *Brain Research*, 1079, 4–14.
- Fischer, A. N. A. (Ed.). (2000). *Gender and emotion: Social psychological perspectives* (pp. 71–94). London, England: Cambridge University Press.
- Fivush, R., Brotman, M. A., Buckner, J. P., & Goodman, S. H. (2000). Gender differences in parent–child emotion narratives. *Sex Roles*, 42, 233–253.
- Fraley, R. C., Niedenthal, P. M., Marks, M., Brumbaugh, C., & Vicary, A. (2006). Adult attachment and the perception of emotional expression: Probing the hyperactivating strategies underlying anxious attachment. *Journal of Personality*, 74, 1163–1190.
- Gauthier, J., & Bouchard, S. (1993). Adaptation canadienne-française de la forme révisée du State–Trait Anxiety Inventory de Spielberger [A French-Canadian adaptation of the revised version of Spielberger's State–Trait Anxiety Inventory]. *Canadian Journal of Behavioral Science*, 25, 559–578.
- Gunnar, M., & Donahue, M. (1980). Sex differences in social responsiveness between six months and twelve months. *Child Development*, 51, 262–265.
- Hauck, F. R., Omojokun, O. O., & Siadaty, M. S. (2005). Do pacifiers reduce the risk of sudden infant death syndrome? A meta-analysis. *Pediatrics*, 116, 716–723.
- Hennenlotter, A., Schroeder, U., Erhard, P., Catrop, F., Haslinger, B., Stoecker, D., ... Ceballos-Baumann, A. O. (2005). A common neural basis for receptive and expressive communication of pleasant facial affect. *NeuroImage*, 26, 581–591.
- Howard, C. R., Howard, F. M., Lanphear, B., Eberly, S., deBlicq, E. A., Oakes, D., & Lawrence, R. A. (2003). Randomized clinical trial of pacifier use and bottle-feeding or cupfeeding and their effect on breastfeeding. *Pediatrics*, 111, 511–518.
- Maringer, M., Krumhuber, E., Fischer, A. H., & Niedenthal, P. M. (2011). Beyond smile dynamics: Mimicry and beliefs in judgments of smiles. *Emotion*, 11, 181–187.
- Marter, A., & Agruss, J. C. (2007). Pacifiers: An update on use and misuse. *Journal for Specialists in Pediatric Nursing*, 12, 278–285.
- Mikolajczak, M., Luminet, O., Leroy, C., & Roy, E. (2007). Psychometric properties of the Trait Emotional Intelligence Questionnaire: Factor structure, reliability, construct, and incremental validity in a French-speaking population. *Journal of Personality Assessment*, 88, 338–353.
- Mitchell, E. A., Blair, P. S., & L'Hoir, M. P. (2006). Should pacifiers be recommended to prevent sudden infant death syndrome? *Pediatrics*, 117, 1755–1758.
- Mojzisch, A., Schilbach, L., Helmert, J., Pannasch, S., Velichkovsky, B., & Vogele, K. (2006). The effects of self-involvement on attention, arousal, and facial expression during social interaction with virtual others: A psychophysiological study. *Social Neuroscience*, 1, 184–195.
- Neal, D. T., & Chartrand, T. (2011). Embodied emotion perception: Amplifying and dampening facial feedback modulates emotion perception accuracy. *Social Psychological and Personality Science*, 2, 673–678.
- Niedenthal, P., Brauer, M., Halberstadt, J., & Innes-Ker, A. (2001). When did her smile drop? Facial mimicry and the influence of emotional state on the detection of change in emotional expression. *Cognition and Emotion*, 15, 853–864.
- Niedenthal, P. M. (2007). Embodying emotion. *Science*, 316, 1002–1005.
- Niedenthal, P. M., Rychlowska, M., Brauer, M., Augustinova, M., Droit-Volet, S., & Korb, S. (2012). [Perceptions and mimicry of children with pacifiers]. Unpublished raw data.
- Oberman, L., Winkielman, P., & Ramachandran, V. S. (2007). Face to face: Blocking facial mimicry can selectively impair recognition of emotional expressions. *Social Neuroscience*, 2, 167–178.
- Petrides, K. V., Sangareau, Y., Furnham, A., & Frederickson, N. (2006). Trait emotional intelligence and children's peer relations at school. *Social Development*, 15, 537–547.
- Rosen, W., Adamson, L., & Bakeman, R. (1992). An experimental investigation of infant social referencing: Mother's messages and gender differences. *Developmental Psychology*, 28, 1172–1178.
- Rovers, M. M., Numan, M. E., Langenbach, E., Grobbee, D. E., Verheij, T. J., & Schilder, A. G. (2008). Is pacifier use a risk factor for acute otitis media? A dynamic cohort study. *Family Practice*, 25, 233–236.
- Sigman, M., & Karsari, C. (1994, June). *Social referencing shared attention and empathy in infants*. Paper presented at the International Conference on Infant Studies, Paris France.
- Simpson, J. A., Rholes, W. S., & Phillips, D. (1996). Conflict in close relationships: An attachment perspective. *Journal of Personality and Social Psychology*, 71, 899–914.
- Sonnby-Borgström, M. (2002). Automatic mimicry reactions as related to differences in emotional empathy. *Scandinavian Journal of Psychology*, 43, 433–443.
- Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.
- Stel, M., & Van Knippenberg, A. (2008). The role of facial mimicry in the recognition of affect. *Psychological Science*, 19, 984–985.
- Want, S. C., & Harris, P. L. (2002). How do children ape? Applying concepts from the study of non-human primates to the developmental study of “imitation” in children. *Developmental Science*, 5, 1–13.
- World Health Organization/United Nations Children's Fund. (1989). *Protecting, promoting and supporting breastfeeding: The special role of maternity services*. Retrieved from <http://whqlibdoc.who.int/publications/9241561300.pdf>
- Zahn-Waxler, C., Radke-Yarrow, M., Wagner, E., & Chapman, M. (1992). Development of concern for others. *Developmental Psychology*, 28, 126–136.