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SYNOPSIS

Objective. The aim of this study was to test whether and to what extent inducing attentional bias in mothers toward a child's positive emotions using a micro-trial method would improve mothers' emotional and behavioral reactions in parenting-related situations. Effects on children were also assessed. ***Design.*** Forty-two mothers of 4- to 5-year-old children participated. Half of the mothers were exposed to an attention bias modification task designed to elicit a transient bias toward positive stimuli. After the manipulation, they were observed during a free-play session and frustration laboratory tasks designed to elicit positive and negative emotions. ***Results.*** Mothers exposed to the attention bias modification task displayed more positive emotional and behavioral reactions toward their child during both free-play and frustration tasks. Their children also behaved better, especially during the free-play session. The influence of mothers' attention allocation on children's outcomes was mediated by mothers' behavior. ***Conclusions.*** An attention bias modification program is useful in improving interactions between mothers and children.

INTRODUCTION

Attentional bias refers to the tendency to allocate attention resources to emotionally salient stimuli (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & Van IJzendoorn, 2007). Bias in attention processes can either be "corrected" to treat stress-related symptoms due to hypervigilance to emotionally negative stimuli (Mogoaşe, David, & Koster, 2014) or transiently induced in healthy participants to test the influence of attentional bias on their emotional and behavioral reactions in stressful situations (Kakoschke, Kemps, & Tiggemann, 2014; MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002). Correction or induction is obtained through attention bias modification (ABM) procedures (Boettcher et al., 2013; Browning, Holmes, Murphy, Goodwin, & Harmer, 2010). The aim of the current study was to innovatively test (1) whether and to what extent inducing attentional bias in mothers toward children's positive emotions through ABM would contribute to improving mothers' emotional and behavioral reactions toward their child in parenting-related stressful situations; and (2) whether mothers' reactions improve children's own emotional and behavioral reactions in the context of the dyadic interaction.

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Why is ABM relevant in the parenting study domain? Parenting is regarded as one of the most demanding roles in adulthood and is recognized as a highly complex task involving stressful situations (Abidin, 1992). Extrafamilial (e.g., unemployment), interpersonal (e.g., marital conflict), and child (e.g., disobedience) stressors have been identified (Anthony et al., 2005; Bonds, Gondoli, Sturge-Apple, & Salem, 2002; Crnic, Gaze, & Hoffman, 2005; Mash & Johnston, 1990; Ostberg & Hagekull, 2000). Parenting can, therefore, be challenging for parents who feel that the demands of rearing their child exceed their available resources.

The adverse psychological reaction resulting from the mismatch between perceived parenting demands and available psychological (e.g., parental self-efficacy beliefs) and concrete (e.g., partner support) resources has been termed parenting stress (Deater-Deckard, 1998). Parenting stress has been associated with parents' perceptions of the quality of parent–child dyadic interaction and with their concrete behavior toward children (Crnic et al., 2005). Also, experiencing parenting stress in daily situations is correlated with low ratings of mutual enjoyment in dyadic interactions (Crnic et al., 2005) as well as disjointed and less coordinated parent–child interactive patterns (Moss, Rousseau, Parent, St-Laurent, & Saintonge, 1998). In addition, parenting stress has been associated with negative consequences in children's outcomes, such as higher rates of internalizing and externalizing disorders, both concurrently (Bagner et al., 2009; Crnic et al., 2005; Guajardo, Snyder, & Petersen, 2009) and longitudinally (Bayer, Hiscock, Ukoumunne, Price, & Wake, 2008; Mantymaa, Puura, Luoma, Salmelin, & Tamminen, 2006), even after controlling for parent psychopathology (Bayer et al., 2008). Such empirical evidence underscored the relevance of testing the effectiveness of new paradigms aimed at reducing mothers' vulnerability to stress in parenting-related situations.

Why may such a focused intervention be relevant in the parenting study domain? Several evidence-based studies have reported the effectiveness of extensive parenting programs in reducing parenting stress, as well as in improving parents' emotional and behavioral reactions (Hautmann, Hanisch, Mayer, Plück, & Döpfner, 2008; Larsson et al., 2009). Meta-analytic reviews have reported a moderate effect size (ES) of parenting programs on such outcomes, with a mean parent ES of .43 for example (Kaminski, Valle, Filene, & Boyle, 2008). However, these programs were multimodal, manipulating both cognitive and behavioral parenting variables, preventing from determining which of their components were effective (Eisenberg, Champion, & Ma, 2004; Leijten et al., 2015). Accordingly, updated research on the effectiveness of specific interventions is necessary. An innovative methodology for exploring this issue has been designed in the form of micro-trials (Howe, Beach, & Brody, 2010), defined as "randomized experiments testing the effects of relatively brief and focused environmental manipulations designed to suppress specific risk mechanisms or enhance specific protective mechanisms, but not to bring about full treatment or prevention effects in distal outcomes." Micro-trials have recently been conducted in parenting research (Leijten et al., 2015; Loop & Roskam, 2016; Mouton & Roskam, 2015; Roskam, 2015) and show a potential to contribute to understanding change processes on which parenting interventions can be built.

To what extent can an improvement of mothers' emotional and behavioral reactions through ABM be expected? Although no previous findings have been reported for ABM effectiveness in parenting research, mood induction has been previously used in empirical research. Inducing temporary positive moods in mothers would lead to more positive evaluation of their children's behavior in comparison with a temporary negative or neutral mood (Jouriles & Thompson, 1993). The effect of negative mood induction in mothers has also been observed in their interactions with their children (Jouriles, Murphy, & O'Leary,

1989; Zekoski, O'Hara, & Wills, 1987). Mothers in a negative mood induction condition were less successful in eliciting positive responses from their children than controls, and their children were sensitive to negative mood and less responsive to their mothers than were controls (Zekoski et al., 1987). Also, mothers in the negative mood condition engaged less in verbal interaction, and their children in turn were less compliant (Jouriles et al., 1989). However, mood induction procedures usually use only a single type of facial expression: positive-happy to induce a positive mood state, or negative (sadness or anger) to induce a negative or stressed state (Falkenberg, Kohn, Schoepker, & Habel, 2012). Classicaly, mood induction procedures precede an experimental task and aim to observe the role of a particular mood state on attention processing. Moreover, the induced mood is transient and induction is not intended to trigger durable changes. Conversely, in an ABM paradigm, spatial attention is directly targeted. For this reason, two facial expressions (positive and negative) are presented together on the left and the right side of a screen preventing the induction of a specific mood state. Attention is trained as the participants are instructed to press the button on the side where a target appeared as soon as possible. Because the target (almost) always replaces happy faces rather than negative ones, participants learn to look at the positive faces. This implicit training strategy also differs from emotional priming tasks, where faces or words with positive and negative valence are presented before other emotional stimuli to influence processing.

In the absence of previous findings on ABM effectiveness in parenting research, hypotheses can be formed on the basis of studies examining the effects of inducing an attentional bias in participants' emotional and behavioral reactions. To remain within the scope of the current study conducted with healthy mother–child dyads, we limited the literature review to studies of healthy participants. Several studies have demonstrated that attention retraining has sustained effects in clinical samples of participants with anxiety, depression, or drinking or eating behaviors (see Lopes, Viacava, & Bizarro, 2015, for a review) and in non-clinical samples (see Emmelkamp, 2012; for a review; see also Kemps, Tiggemann, & Elford, 2015; for an example in non-referred women); subjects in the latter category may be especially suggestible as they do not suffer from an underlying attention bias.

The majority of studies testing ABM efficacy with regard to emotional and behavioral reactions in stressful situations have used a computerized attention-training procedure. This method was mainly inspired by the dot-probe task which was initially designed to assess cognitive bias (MacLeod, Mathews, & Tata, 1986). In this task, participants sit in front of a computer screen and look at a fixation cross at the center of the screen. Two stimuli consisting of words or faces, one of which is neutral and one of which is threatening, appear randomly on either side of the screen. The stimuli are presented for a predetermined duration, before a dot is presented in the location of one of the two former stimuli. Participants are instructed to indicate the location of this dot as quickly as possible, either via the keyboard or using a response box. Latency is measured automatically by computer. The fixation cross appears again for several seconds, and then the cycle is repeated. Quicker reaction times (RTs) to the dot (when it occurs in the previous location of a threatening stimulus) are interpreted as vigilance to threat (MacLeod et al., 1986). In the modified version of the dot-probe task used to retrain attentional bias (the ABM task), the probe replaces the neutral stimuli 95% of the time or the salient stimuli 95% of the time. Over the course of a number of trials, attentional bias toward salient stimuli can be reduced (in the case of the "replace-neutral" condition) or enhanced (in the case of the "replace-salient" condition; Mathews & MacLeod, 2002).

One of the first studies to report the results of an ABM task involved university students (MacLeod et al., 2002). Immediately after completing an ABM session, participants were exposed to a final standardized stress task designed to elicit a negative mood state. Compared to the control condition, participants in the experimental condition displayed higher emotional vulnerability, as revealed by participants' emotional reactions to the final standardized stress task. Very similar findings were displayed in another study conducted with healthy women (Suway et al., 2013). Facial stimuli consisting of angry and neutral expressions were displayed in the ABM task to train attention bias toward threat. A higher self-reported depression vulnerability was reported for those in the experimental condition after being exposed to stress-induction tasks (Suway et al., 2013). However, in a pre-/post-test design where participants had to complete questionnaires about mood states and negative thoughts toward the self before and after one session of attention training, Beshai, Prentice, Dobson, and Nicpon (2014) failed to find a main effect of the condition. In this study, the ABM task was based on neutral-negative face pairs and used to elicit a transient attentional bias toward negative emotions. Although the manipulation was effective at eliciting such a bias among participants in the experimental condition, they displayed similar levels of negative moods and thoughts to the controls (Beshai et al., 2014). However, this study was not completely comparable to those of MacLeod et al. (2002) and Suway et al. (2013) because participants in the Beshai et al. (2014) study were not exposed to a stressful situation after the ABM task. They simply completed post-training self-report measures. Moreover, it could be argued that emotional reactions assessed through self-report differ from those observed in a stressful situation appealing to a different level of consciousness.

In addition to such laboratory studies, one study conducted with students tested whether attentional bias also contributed to real-world emotional vulnerability (See, MacLeod, & Bridle, 2009). The participants were students who had to immigrate for their studies. By contrast with the laboratory studies where a transient bias to negative stimuli was elicited, the participants were experimentally induced to demonstrate attentional avoidance of negative information. An ABM task based on emotionally neutral-emotionally negative word pairs was used in a 15-day home-based training program. The authors examined the influence of the ABM task on students' anxiety with regard to the stressful life event of immigration. ABM served to reduce emotional reactions, in particular trait anxiety scores and state anxiety responses to the subsequent naturalistic stressor.

ABM is also effective at modifying behavioral responses. For example, unhealthy eating is considered to be a behavioral response to biased attentional processing (Kakoschke et al., 2014). Undergraduate women attended an ABM task session which was designed to allocate their attention toward either unhealthy food (negative stimuli) or healthy food (positive stimuli) rather than to neutral stimuli as in previous research. Immediately afterward, they were asked to rate four different snacks (i.e., two healthy and two unhealthy) on several dimensions. The snacks were presented in four bowls, and the women were told that they could try as much of the food as they liked. Each bowl was weighed before and after the taste test. The authors reported that the women from the experimental group ate more of the healthy snacks and less of the unhealthy snacks than the controls, suggesting that ABM was also effective at modifying behavioral outcomes.

Overall, among healthy participants, the results of the studies reviewed suggest that eliciting a transient attentional bias toward negative stimuli contributes to more negative emotional and behavioral reactions (Kakoschke et al., 2014; MacLeod et al., 2002;

Suway et al., 2013), except in the study of Beshai et al. (2014). Also, inducing attentional avoidance of negative information contributes to less negative emotional reactions (See et al., 2009). Conversely, allocating participants' attention to positive stimuli contributes to more positive behavioral reactions (Kakoschke et al., 2014). Transposing these findings to parenting research, an improvement in mothers' emotional and behavioral reactions through ABM was expected. Although it was impossible to precisely relate emotional and behavioral outcomes from previous studies to parenting reactions, allocating mothers' attention toward positive children's faces rather than to negative ones was expected to modify their emotional and behavioral reactions toward their child. In particular, emotional and behavioral responsiveness was expected to be enhanced, because responsiveness relies on synchrony and contingency, which would occur when mothers allocated their attention to their children's reactions and reacted accordingly. In turn, responsiveness was expected to increase mothers' involvement, resulting in greater affect in mothers. Sensitive responsiveness is also interpreting negative signals of the child, such as distress expressed during frustration tasks. Focusing mothers' attention to facial expression, rather than on material issues, may result in high level of responsiveness toward children's emotional signals.

The final question of the current research was: Why may inducing attentional bias toward emotionally positive stimuli in mothers contribute to improving children's emotional and behavioral reactions? If an improvement of mothers' emotional and behavioral reactions through ABM was achieved, it was expected from previous studies in parenting research that children's emotional and behavioral reactions toward their mothers would improve in turn. Cross-sectional and longitudinal relations between mothers' emotional and behavioral reactions and children's outcomes have been extensively documented in the literature (Baker, Fenning, & Crnic, 2011; Kazak, 2004; Kwon & Elicker, 2012; Rinaldi & Howe, 2012; Shumow & Lomax, 2002; Zimmer-Gembeck & Thomas, 2010). In particular, responsive and warm parenting promotes a broad range of highly valued developmental outcomes in children, such as a sense of security, social and emotional competence, verbal ability, or intellectual achievement (Bornstein, 1989; Davidov & Grusec, 2006; Watson et al., 2014). Besides correlational research, quasi-experimental studies have shown that mothers' reactions influence those of children. For example, enhancing mothers' reactions to their children's emotions improves mothers' emotional and behavioral reactions toward their children and their children's reactions (Loop & Roskam, 2016). Children interacting with mothers whose reactions have been immediately reinforced display higher persistence and enthusiasm toward the tasks they have to achieve. The same influence of mothers' emotional and behavioral reactions on children's non-compliance was found when mothers' verbal responsiveness had been reinforced (Brassart & Schelstraete, 2015; Roskam, Brassart, Loop, Mouton, & Schelstraete, 2015).

The current study consisted of a randomized controlled micro-trial testing (1) whether and to what extent eliciting a transient attentional bias toward emotionally positive stimuli in mothers contributes to improving emotional and behavioral reactions in stressful parenting-related situations; and (2) whether mothers' reactions in turn relate to children's reactions. In line with the objectives, half of the mothers were exposed to an ABM task based on emotionally negative or positive children's face pairs designed to elicit a transient bias toward positive stimuli. The other half completed a placebo task. Immediately afterward, mothers and their children were observed during a free-play session (low-stress induction situation) and standardized frustration tasks (high-stress induction situation). First, we expected that, compared to the control condition, trained mothers would display more positive emotional

and behavioral reactions toward their children. Second, the effect of the experimental manipulation was also tested on children's reactions in the context of the dyadic interaction: We expected that, compared to controls, children of trained mothers would display more positive emotional and behavioral reactions. Finally, we expected that the effect of the experimental manipulation on children's reactions would be mediated by mothers' reactions.

METHOD

Sample

Data were collected as part of the longitudinal H2M (Hard-t(w)o-Manage) Children research program conducted at the Psychological Sciences Research Institute of the University of Louvain in Belgium. A community sample of 42 volunteer mothers and their 4- to 5-year-old preschoolers participated. Thirty-nine were Belgian, two were European citizens, and one non-European. Sociodemographic information about the sample is presented in Table 1.
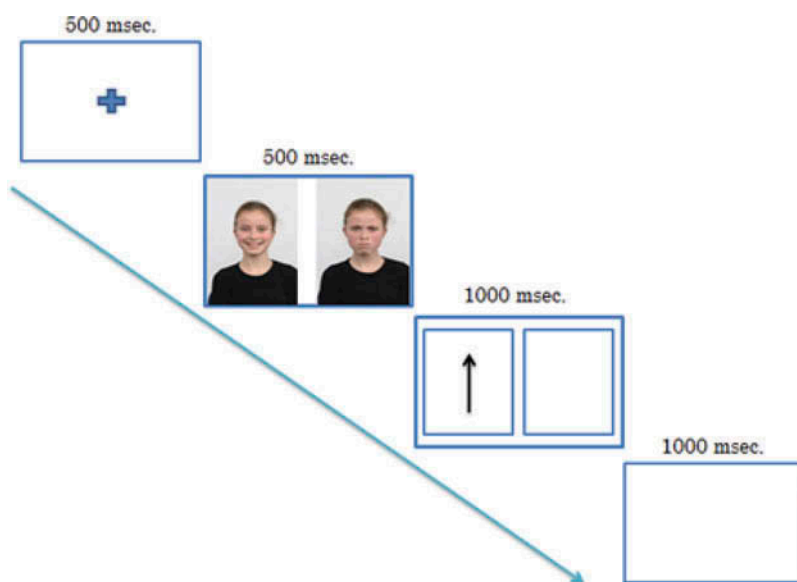
Procedures

Twenty-one dyads were randomly assigned to the experimental group, and the other 21 to the control group, on the basis of order of recruitment. Mothers and their children were recruited through leaflets and posters, distributed in schools, stores, and a sports complex in the five French-speaking districts in Belgium, and on a website and social network pages. The study was approved by the Institutional Ethical Committee of the University of Louvain. Participants received small rewards for their participation (i.e., entry tickets to museums, small toys, or shopping vouchers provided by sponsors).

TABLE 1
Descriptive Statistics on Sociodemographic Characteristics for Experimental and Control Groups

	Experimental (n = 21)	Control (n = 21)	Total (n = 42)	
	M (SD)	M (SD)	M (SD)	
Mother's age (years)	37.00 (4.13)	35.81 (3.56)	36.40 (3.86)	$t(40) = -1.00, p > .10, d = .30$
Child's age (months)	57.28 (7.18)	60.76 (7.73)	59.02 (7.57)	$t(40) = 1.51, p > .10, d = .46$
Child's gender (% boys)	47.6%	33.3%	40.5%	$X^2(1) = .89, p > .10$
Educational level				$X^2(1) = 3.06, p > .10$
Secondary and high school	42.85%	66.66%	54.76%	
University and higher	57.15%	28.58%	42.86%	
Missing data	0%	4.76%	2.38%	
Mother's income				$X^2(1) = 2.33, p > .10$
<4000 euros	47.62%	57.14%	52.38%	
>4000 euros	47.62%	19.04%	33.33%	
Missing data	4.76%	23.82%	14.29%	
Families (%):				
Two Parents household	100%	100%	100%	
Other	0%	0%	0%	

Materials. An ABM task was used to train participants to allocate their attention to emotionally positive children's faces and to avoid negative emotional information. The ABM task was based on positive–negative face pairs. Negative stimuli (emotionally negative children's faces) were paired with positive stimuli (emotionally positive children's faces) rather than neutral stimuli, because these pairs had greater ecological validity (i.e., children rarely display neutral expressions in everyday life). The stimulus set comprised 30 color pictures of 10 different children (5 boys and 5 girls) each displaying anger, sadness, and happiness, taken from the Radboud Faces Database (RaFD; Langner et al., 2010). All stimuli were presented on a monitor, placed 0.5 m away from the participant. The faces were enclosed in a rectangular frame measuring 6 by 8 cm, subtending a visual angle of 6.9 × 9.2. The facial displays consisted of two photographs of the same child presented on the left and the right side of the screen. Mothers were given the following instruction: "Press the button on the side where the diamond appears as soon as possible." The participants had two buttons: one on the right and one on the left. First, a fixation cross appeared for 500 msec to direct attention toward the center of the screen. Next, two faces were displayed for 500 msec with a combination of happiness/anger or happiness/sadness. An arrow then appeared for 1000 msec in the place of one of the two faces. In 95% of cases, it appeared on the side of the positive emotion to direct mother's attention toward the positive stimulus which was accordingly considered as the "valid" condition, whereas the "invalid" condition referred to arrows replacing negative faces. Finally, a blank screen appeared for 1000 msec to refocus attention on the center of the image. This task consisted of 250 trials divided into 50-trial blocks. Trials were presented in a different random order for each participant. The material is presented in Figure 1. A variety of measures was used to assess behavioral performance. The presentation software automatically calculated RTs and accuracy for each target, and we computed the percentage of correct responses (errors could be an erroneous response, an absence of response within the given time, or a response occurring before the target presentation or less than 200 msec after its onset) and the average RT for correct responses.

FIGURE 1
Presentation of the dot probe task.

Experimental Manipulation Procedure. Six trained experimenters blind to the goals of the overall experiment were involved in data collection. The experimental procedure was structured in four steps described in a standardized manual. First, before coming to the Parenting Lab, mothers were asked to fill in a set control measures about their self-efficacy beliefs and temperament and about their children's temperament and behavior. Second, mothers and their children came to the Parenting Lab. The mothers allocated to the control group watched a 15-minute video in a quiet laboratory room. The video focused on general topics in child development, such as sleeping, thinking, and playing. In particular, the video described child development from birth to 5-years-old, for example by stating how many hours of sleep a child needs at what age, at what age children gain a sense of identity, or at what age children are able to make a block tower. The video made no reference either to children's emotional development or to parents' role. This placebo task has been used in two previous micro-trial studies (Brassart & Schelstraete, 2015; Loop & Roskam, 2016). Mothers in the experimental group completed the 15-minute ABM task in a quiet laboratory room. During this time, the child played with the experimenter in the testing room according to a standardized procedure. In particular, figurines and drawing material were provided. The experimenter invited the child to play while he/she simply stayed without giving any guidelines to the child. After the manipulation, in the third step, mothers played with their child following a standardized procedure consisting of free-play followed by three successive frustration tasks, for approximately 25 minutes. The frustration tasks were "impossible to solve" tasks, in particular a 5-minute disappointment task (Cole, Zahn-Waxler, & Smith, 1994) and two, 5-minute "impossible collaboration" tasks (i.e., a puzzle and a Lego task; Melnick & Hinshaw, 2000). The free-play task involved a very common play situation giving rise to positive emotions on the part of the children. A low level of stress was nevertheless induced due to the unfamiliar situation of a video-recorded interaction in a laboratory setting. The three successive frustration tasks were related to unworkable situations designed to generate higher levels of stress. Both mothers' and children's behavior were coded at this step to test our hypotheses. In the final step, the experimenter debriefed every mother explaining the goal of the study and the manipulation procedure. Children were also thanked for their participation and received small gifts.

Measures

Mothers' self-efficacy beliefs were assessed with the Global Parental Self-Efficacy Scale of Meunier and Roskam, a 25-item Likert scale related to five domain-specific self-efficacy factors: Discipline, Nurturance, Playing, Instrumental Care, and Teaching. The measure has been validated on 705 mothers and displayed good psychometric properties according to Meunier and Roskam (2009): five-factor solution explaining 53.1% of the variance, α ranging from .60 to .84. Data collection was limited to the Discipline and Nurturance scales, and a mean score of self-efficacy beliefs was averaged from the two scales (α = .78).

Mothers' temperament was measured on the dimensions of Emotionality, Activity, and Sociability using 20 Likert 5-point items (Buss & Plomin, 1984). Emotionality was further divided into three subscales: Fear, Anger, and Distress. The internal consistency of the five scales (Fear, Anger, Distress, Activity, and Sociability) ranged in the French-validated version from .62 to .80 (Rouxel, Briec, Juhel, & Le Maner-Idrissi, 2013). The internal consistency for the current sample ranged from .69 to .82.

Child behavior was measured using the preschool version of the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2004). The CBCL uses 3-point Likert scales (1 = *not at all present*, 2 = *moderately present*, and 3 = *often present*). In the current study, data collection was limited to two first-order scales: the "internalized-anxiety" and "externalized-aggressive behavior" scales. The psychometric properties of the initial version of the scale were good, with α of .76 for "internalized-anxiety" and of .96 for "externalized-aggressive behavior," and *r* = .68 and .87 for test–retest reliability (Achenbach & Rescorla, 2004). The internal consistency for the current sample was .90 for the externalized scales and .83 for the internalized scale.

Child temperament was assessed with the Children's Reactions Questionnaire–Very Short Form (CBQ-VSF; Putman, Gartstein, & Rothbart, 2006). The CBQ-VSF is a brief 36-item caregiver report of temperament in 3- to 8-year-old children consisting of two reactive factors, Surgency and Negative Affectivity, and a regulatory factor, Effortful Control. For each question, mothers rated their children on a 7-point Likert scale (1 = *extremely untrue of your child* and 7 = *extremely true of your child*). They could also choose a "not applicable" response if their child's behavior did not match with the described situation. The CBQ-VSF presented high internal consistency for each dimension across samples, ranging from .62 to .78, satisfactory criterion validity, and stability over time. The internal consistency for the current sample ranged from .68 to .81.

Mothers' and children's emotional and behavioral reactions were observed using the Crowell Mother–Child Interaction Task procedure (MCIT; Crowell & Feldman, 1988). This technique consists of a 45- to 60-minute observation of caregiver–child interactions in a semi-structured play session. It involves a series of episodes designed to elicit reactions showing how comfortable and familiar the dyad members are with each other, their ability to solve problems together, and their use of shared positive or negative affect. The initial procedure consists of (1) 10 minutes of free-play; (2) a 5-minute clean-up task; (3) a series of four tasks graded by difficulty in which dyads worked at their own pace; and (4) a 2-minute separation–reunion of the dyad. In the current study, three frustration tasks replaced the clean-up and the four subsequent tasks. Due to the common nature of these three tasks, mothers' and children's reactions were coded into a global score corresponding to the mean of the tasks. Outcomes were consequently examined in two time sequences: the 10-minute free-play session (low-stress-induction task ranging from 1 to 7) and the 15-minute frustration tasks (high-stress-induction tasks ranging from 3 to 21). The 2-minute separation–reunion was eliminated because of its lack of relevance to this study.

Mothers' emotional and behavioral reactions were coded using six Crowell MCIT mother scales (7-point Likert scales). The scales included the mother's behavioral responsiveness (reflecting her behavior in regard to her level of instrumental support of the child; at the high end of the scale the mother's support matched the child's age and/or developmental level), emotional responsiveness (reflecting her level of emotional support and responsiveness in regard to task completion; at the high end of the scale the mother reinforces, anticipates distress, and expresses strong enthusiasm and encouragement), positive affect (reflecting the extent to which the mother smiled, laughed, and was animated in her interaction with the child), irritability (reflecting the mother's degree of irritability, anger, and/or hostility exhibited toward the child, including such behaviors as becoming visibly frustrated with the child and treating the child in a punitive manner), withdrawal/indifference (reflecting the mother's withdrawal from or lack of interest in the interaction with the child with an affective tone of sadness or melancholy), and aggression toward the child (reflecting the level of aggression exhibited by the mother toward the child). Coding was done by six independent

coders, trained by one coder certified by the University of Tulane (United States), with a mean intercoder reliability of .92 calculated with the weighted Kappa coefficient on 25% of the sample. Each coder was blind to participant allocation to experimental or control groups and only coded unknown dyads.

Children's emotional and behavioral reactions were measured using seven Crowell MCIT child scales (7-point Likert scales). Positive affect (involving the child seeking out the mother's attention with positive intent, for example, smiling at, laughing with the mother), withdrawal/indifference (reflecting the child's withdrawal due to sadness or depression, rather than an avoidant type of withdrawal due to anger, hostility, or indifference), irritability (including fussing, pouting, angry withdrawal, or punitive behavior directed to the mother in response to the mother's behavior), compliance (measuring the degree to which the child listened to the mother's suggestions throughout the session and complied with her requests), aggression (measuring the extent to which the child showed verbally or physically aggressive behavior toward the mother), persistence (measuring the extent to which the child was problem-oriented and focused on the task throughout the session), and enthusiasm (measuring the extent to which the child took pleasure in the task) were coded.

Data Analysis

We preliminarily checked the distribution of the variables. Skewness and kurtosis indicated that five variables displayed deviations from normality (parents' irritability in free-play and frustration tasks, children's irritability in frustration tasks, and children's non-compliance in free-play and frustration tasks). Log transformations of these variables were computed and ensured a normal distribution. The main analyses were then performed twice, once using the transformed variables and once using the original variables. As the results were similar, only results obtained from the analyses computed on the original variables were presented.

Two preliminary analyses were performed. The first consisted of checking the comparability of the experimental and control groups on baseline measures. The second was the manipulation check. Three analyses were conducted to verify (1) the accuracy of the mothers' responses; (2) the decrease of the mothers' RTs (mean) in the valid condition (emotionally positive children's faces); and (3) the decrease of the mothers' RTs (mean) in the valid condition (emotionally positive children's faces) across the trials. Trials with response times exceeding 2 standard deviations (SDs) beyond the mean (M) were excluded.

As a first main analysis, Multiple Analysis of Variances (MANOVAs) with the group condition (i.e., trained versus not trained) as the independent variable and parents' or children's reactions as outcomes were computed in the two tasks (i.e., the free-play and frustration tasks). Cohen's d for ESs were also computed. However, the results on the mothers' and children's aggression and withdrawal/indifference scales showed no variance, with very low scores as expected for a community sample. These scales were, therefore, excluded from our analyses.

Finally, we conducted a mediation analysis to test whether ABM influenced mothers' reactions toward their children, which in turn related to the children's reactions. This analysis relied on the regression-based approach of Hayes (2013). To limit the number of variables in the mediation analysis, mothers' reactions were averaged from the emotional responsiveness, behavioral responsiveness, positive affect, and irritability scales.

Correlations between scales ranged from .30 to .87, with reliability indices of .84 and .81, respectively, in free-play and frustration tasks. Children's reactions were also averaged from the positive affect, irritability, non-compliance, enthusiasm, and persistence scales. Correlations between scales ranged from .22 to .72 with reliability indices of .76 in both free-play and frustration tasks. The current mediation analysis did not provide p-values and so interpretation relied on the two confidence interval (CI) bounds. When these were both positive or negative, it could be assumed that in 95% of the cases, the estimated coefficient (the product between two coefficients) differed from zero, in other words that there was an indirect effect of the variable x (the group condition) on y (children's reactions) through the mediator (mothers' behavior). In the current study, the number of bootstrap samples for percentile bootstrap CI was 10,000. The level of confidence for the CI was 95.

RESULTS

Preliminary Analyses

As reported in Table 1, comparisons between the equivalence measures of experimental and control groups revealed no difference. In the two groups, parents were of similar age, gender, income, and education level. Their children lived in similar families in terms of composition and had the same age and gender. As reported in Table 2, mothers from the two groups also had similar levels of self-efficacy beliefs, meaning that they felt similarly confident in the areas of discipline and nurturance. No difference was found in mothers' and children's temperament or their internalized and externalized behaviors. The only two exceptions related to mothers' tendency to emotionality with regard to anger and children's tendency to effortful control. In sum, the results of group equivalence analyses indicated that thanks to randomized allocation, the experimental and control groups could be considered similar at baseline except for mothers' emotionality (anger) and children's effortful control.

TABLE 2
Descriptive Statistics for the Group Equivalence Measures in the Experimental and the Control Groups

	Experimental (n = 21)		Control (n = 21)			
	M	SD	M	SD	$t(40)$	Cohen's d
Mothers' self-efficacy beliefs						
Mothers' temperament	3.89	.48	3.94	.54	.30, p > .10	.09
Emotionality (fear)	2.52	.53	2.45	.94	−.30, p > .10	.09
Emotionality (anger)	2.71	.74	3.12	.71	1.83, p > .05	.56
Emotionality (distress)	2.69	.63	2.77	.85	.36, p > .10	.10.
Activity	2.88	.55	2.79	.72	−.42, p > .10	14
Sociability	3.33	.73	3.59	.63	1.23, p > .10	.38
Children's temperament						
Surgency	4.41	.94	4.59	.86	.65, p > .10	.20
Negative affectivity	4.29	.72	4.40	1.18	.38, p > .10	.11
Effortful control	5.29	.62	5.70	.80	1.86, p > .05	.57
Children's externalizing behavior	10.76	7.28	11.25	7.30	.21, p > .10	.06
Children's internalizing behavior	3.19	3.72	3.05	2.63	−.14, p > .10	.04

The main analyses therefore control for these two variables. Descriptive statistics and the results of *t*-tests are presented in Tables 1 and 2.

The results of the ABM tasks suggested a tendency for higher accuracy in response to valid (98.0%) as compared to invalid (94.7%) trials, $t(20) = 1.86$, $p = .07$, $d = 37$. To assess the effects of ABM on task performance, RT means were subjected to a 2 (valid versus invalid trial) × 2 (happiness/anger versus happiness/sadness) analysis of variance (ANOVA). Finally, we tested whether mothers' RT (mean) decreased in the valid condition across the trials by performing a 2 (happiness/anger versus happiness/sadness) × 5 (five blocks) ANOVA. The expected differences were not found.

ABM Effect on Mothers' Reactions

As presented in Table 3, the MANOVAs controlling for mothers' emotionality (anger) and children's effortful control confirmed that ABM improved mothers' reactions toward their children. Compared to the control condition, trained mothers reacted more positively toward their children during the free-play session, $F(4,35) = 3.19$, $p < .05$, partial $\eta^2 = .27$, but not during the frustration tasks, $F(4,35) = 1.74$, $p > .05$, partial $\eta^2 = .16$. Nevertheless, positive reactions persisted to some extent during the frustration tasks. For free-play, between-subjects effects showed that ABM had a positive effect on three MCIT parent scales (emotional responsiveness, behavioral responsiveness, and positive affect). During the frustration tasks, a significant difference was found between the two groups for mothers' positive affect and two trends toward both behavioral and emotional responsiveness. During these tasks, parents in the experimental group continued to be more behaviorally and emotionally responsive and to display more positive affect than controls.

TABLE 3

Descriptive Statistics of the Measures After the Experimental Manipulation for the Experimental and Control Groups, MANOVAs, and Cohen's *d* Effect Sizes

	Free-Play						Stress-Induction Tasks					
	Experimental (*n* = 21)		Control (*n* = 21)				Experimental (*n* = 21)		Control (*n* = 21)			
	M	*SD*	*M*	*SD*	*F*(1,38)	Cohen's *d*	*M*	*SD*	*M*	*SD*	*F*(1,38)	Cohen's *d*
Mothers' reactions												
Behavioral responsiveness	5.81	.51	5.38	.59	6.39*	.78	5.42	.48	5.11	.67	3.36	.54
Emotional responsiveness	5.86	.36	5.24	.89	5.09**	.99	5.58	.57	5.26	.75	3.35	.47
Positive affect	6.00	.02	5.49	.67	10.83***	1.48	5.82	.36	5.42	.66	7.43*	.77
Irritability	1.05	.22	1.29	.56	1.18	.56	1.08	.18	1.19	.32	1.19	.42
Children's reactions												
Positive affect	5.95	.49	5.19	.68	14.18***	1.30	5.17	.67	5.01	.72	1.84	.23
Irritability	1.05	.21	1.59	.68	9.25**	1.21	1.30	.31	1.36	.51	.13	.14
Non-compliance	1.05	.22	1.29	.64	3.54	.50	1.03	.10	1.15	.39	3.23	.42
Persistence	6.05	.38	5.95	.49	.97	.22	5.15	.89	5.23	.73	.20	.09
Enthusiasm	6.05	.49	5.86	.57	1.69	.35	4.87	.23	4.90	.78	.53	.05

*$p < .05$, **$p < .01$, ***$p < .001$.

ABM Effect on Children's Reactions

As presented in Table 3, ABM was successful for the free-play session, $F(5,34) = 3.20$, $p < .05$, partial $\eta^2 = .32$, but not for the frustration tasks, $F(5,34) = 1.06$, $p > .05$, partial $\eta^2 = .13$. Between-subjects effects showed that during the free-play session, compared to controls, children of trained mothers displayed higher positive affect and lower irritability. Children also tended to display lower non-compliance. During the frustration tasks, no significant differences between the two groups were found except for a tendency for more compliance among children in the experimental group compared to controls.

Mediation Analysis

A mediation analysis was performed on mothers' and children's reactions coded during the free-play session. The direct effect of the group condition on mothers' reactions was $b = .23$, $SE = .06$, $p < .005$, 95% CI $\square.09, .36\square$. The effect of the group condition on children's reactions when controlling for the direct effect of parents' behavior on children's reactions was marginally significant, with $b = .10$, $SE = .05$, $p < .10$, 95% CI [–.01, .22]. The effect of parents' behavior on children's reactions when controlling for the direct effect of the group condition on children's reactions was significant, with $b = .30$, $SE = .12$, $p < .05$, 95% CI [.05, .55]. The hypothesis of an indirect effect of the group condition on children's reactions through mothers' reactions was confirmed with $b = .07$, $SE = .03$, $p = .05$, 95% CI [.01, .14]. In other words, ABM influenced mothers' emotional and behavioral reactions toward their children, which related to the children's reactions during the low-stress-induction task (i.e., free-play). Because no effect was found for the ABM condition on children's reactions in the frustration tasks, no mediation analysis was computed in the frustration tasks.

DISCUSSION

The objectives of the current study were to test (1) whether and to what extent inducing attentional bias toward emotionally positive children's faces through ABM in mothers would contribute to improving their emotional and behavioral reactions toward their children in parenting-related stressful situations; and (2) whether mothers' reactions would in turn improve children's emotional and behavioral reactions. First, we expected that, compared to mothers exposed to a placebo task, mothers exposed to the ABM task would display more positive emotional and behavioral reactions toward their children. Our results supported this first hypothesis. During free-play, compared to controls, mothers in the experimental group displayed higher emotional and behavioral responsiveness and positive affect. They also manifested more positive affect and tended to be more behaviorally and emotionally responsive than controls during frustration tasks. Inducing attentional bias toward emotionally positive children's faces through ABM in mothers contributed to improving their emotional and behavioral reactions toward their children in parenting-related stressful situations. The effectiveness of the manipulation was higher in free-play than in frustration tasks. Several explanations can be provided. It may be that the effectiveness of a 15-minute ABM task was enough to improve mothers' reactions in a situation involving low stress (i.e., free-play), but limited when it came to facing situations eliciting higher stress and frustration. An adequate fit would need to be found between the level of attentional training proposed in an ABM task and the level of stress that individuals

have to cope with. A mismatch between the level of training and the level of stress induced during the frustration tasks would explain the differences found in the results according to the two time sequences. A longer ABM task or a higher number of ABM sessions or trials may be needed to reduce mothers' vulnerability to stress in an effective manner when they face "impossible to solve" tasks with their child. Another explanation could be that the difference between the two time sequences was due to a recency effect. The effectiveness of the attentional training that was given may be limited in time, resulting in a greater effect during the first 10 minute after the ABM task than during the subsequent frustration tasks. The effect would then fade over time until it disappeared completely. A last explanation could be that allocating their attention to children's positive emotions in a highly frustrating situation was not appropriate for mothers. Rather than inducing a transient bias toward or avoidance of negative stimuli as in most previous studies, the current ABM task was designed to induce a transient bias toward emotionally positive stimuli. It may be that allocating attention to positive stimuli in stressful situations was inappropriate because, to be responsive, mothers would need to take account of their children's emotions, whether positive or negative, according to the particular setting. Ignoring children's negative emotions in a highly frustrating situation could be considered an inappropriate and insensitive reaction. At this time, it was impossible to know which of the three explanations (i.e., balance between attentional training and level of stress to cope with, recency effect, appropriateness of allocating attention to children's positive emotions in frustrating situation) would be the best candidate to explain higher effectiveness of the manipulation in free-play than in frustration tasks. Future attempts should be made to replicate the present findings and, further, to test the three explanations by varying the intensity of attentional training and/or the level of stress to cope with, by varying the time sequences, and by taking the context into account rather than simply eliciting avoidance of emotionally negative stimuli or focusing on positive ones.

Second, the experimental manipulation was expected to improve children's emotional and behavioral reactions in the context of the dyadic interaction with their mothers. Our results supported this hypothesis in the context of free-play, whereas only a tendency for the scale "non-compliance" was found during the frustration tasks. In line with previous experimental studies in parenting (Brassart & Schelstraete, 2015; Loop & Roskam, 2016; Roskam et al., 2015), children seemed to be influenced by their mothers' emotional and behavioral reactions. The results suggest that, compared to controls, children's reactions in the experimental group were improved, with higher positive affect and lower irritability. In line with the third hypothesis, the mediation analyses showed that such improvement of children's reactions was obtained thanks to their mothers' positive reactions during free-play.

The current study may be the first to evaluate the influence of ABM on participating subjects but also on other individuals with whom they interacted. In this way, this study opens a new line of research that could be pursued further. It has to be considered as a first attempt conducted with a small sample size in the parenting domain whose results needed to be replicated. First, the results should be interpreted with caution given the fact that baseline attentional biases were not measured. It cannot be excluded that some mothers presented an attentional bias before attending the ABM or the placebo task. Second, the current study was conducted with healthy mother–child dyads. Different effects could be found in a clinical sample with mothers with depression symptoms, for example, or with mothers of children displaying externalizing or internalizing behaviors. Clinical applications of ABM tasks should be developed to

make it possible to test the effectiveness of clinically relevant interventions. As a third limitation, no measure of parental stress was used at baseline to ensure the comparability of the two groups. Therefore, it cannot be excluded that the mothers in the control group were more stressed than those in the experimental condition, and that this difference at baseline explained the post-training effects. Parent and child variables were collected at a single time, and therefore, the direction of effects could not be properly disambiguated. Similarly, in absence of a pre–post design, causality should be considered cautiously. Fifth, we did not consider any moderator that could explain why the ABM task worked better for some dyads than for others. Whereas temperament was measured in the procedure for comparability purposes, moderations were outside the scope of the current study and will have to be considered elsewhere. Differential susceptibility markers, such as genetic indicators, should also be considered in future studies (Belsky, Bakermans-Kranenburg, & Van IJzendoorn, 2007; Belsky & Pluess, 2009; Pitzer, Jennen-Steinmetz, Esser, Schmidt, & Laucht, 2011). As a sixth limitation, it was impossible to know whether and to what extent the effectiveness of the ABM manipulation would persist in the long-term. As noted previously, a recency effect may operate and the ABM effect would fade in the few minutes right after the task. Future studies should consider not only post-training but also follow-up assessments. Finally, the current research validated micro-trials as a relevant method for understanding change processes in which parenting programs can be built, so future attempts should be made to compare brief and focused interventions. ABM's effect on mothers' and children's subsequent emotional and behavioral reactions should be compared with other new insights in the parenting domain, in particular with interventions such as Attention-Feedback-Awareness-and-Control Training (Bernstein & Zvielli, 2014). Unlike an unconscious experimental manipulation such as the one involved in the ABM task, Attention-Feedback-Awareness-and-Control Training would lead participants to consciously gain greater self-regulatory control of their attention. The importance of being conscious about attention allocation could be tested through such a comparison.

IMPLICATIONS FOR PRACTICE, APPLICATION, THEORY, AND POLICY

As an intervention method, ABM would constitute a promising and innovative tool, because (1) a brief 15-minute task produced moderate ESs comparable or even higher than those obtained with multimodal parenting programs (stimulating cognitive and behavioral parenting variable simultaneously; Kaminski et al., 2008); (2) it was not as time-consuming as multimodal interventions; (3) it was easier to implement. It can also be easily combined with other intervention tools and methods; (4) and could be implemented in culturally diverse samples to conduct cross-cultural research in the parenting domain. Third, its effectiveness in reducing mothers' vulnerability to stress could be useful as a preventive intervention for mothers suffering from burn-out (Pelsma, 1989; Procaccini & Kiefaber, 1983), or mothers whose children have a chronic disease or mental health or behavioral problems (Guajardo et al., 2009; Kazdin & Whitley, 2003). The current study shows that inducing a transient attentional bias toward emotionally positive stimuli in mothers is effective at improving their emotional and behavioral reactions toward their children in stressful parenting situations. Moreover, thanks to their mothers' more positive parenting, the children, in turn,

displayed more positive reactions in the context of the dyadic interaction, giving support to the hypothesis of an influence of mothers' reactions on children's outcomes.

ADDRESSES AND AFFILIATIONS

Laurie Loop, Psychological Sciences Research Institute, University of Louvain, 10 place du Cardinal Mercier, 1348 Louvain-la-Neuve, Belgium, laurie.loop@uclouvain.be. Mandy Rossignol is at the University of Mons, and Sarah Galdiolo and Isabelle Roskam at the University of Louvain.

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