

Abstract

Inconsistent results have been reported on the effects of distraction on negative emotions during medical procedures in infants. These differing results may be attributable that the effects are apparent under a mildly stressful medical procedure.

Seventeen infants, 18 preschoolers, and 15 school-aged children who were hospitalized were administered monitoring of vital signs, a mildly stressful medical procedure, by a nurse in a uniform with attractive character designs as a distractor. Consistent with the hypothesis, participating infants showed fewer negative behaviors and lower salivary α -amylase levels when distracted. The results support for the efficacy of distraction in infants under a mildly stressful medical procedure.

Key words

Infancy, Children, Psychological distress, Health care, Treatment

Introduction

Many previous studies have investigated psychological interventions that can be used to alleviate negative emotions produced by medical procedures in older children, and previous research has revealed that breathing exercises (Chambers et al., 2009), relaxation (Jay et al., 1991), modeling (Jay et al., 1987), and providing information about forthcoming medical procedures (Jaaniste et al., 2007) are efficacious for older children in medical settings. However, regarding psychological interventions for negative emotions associated with medical procedures in infants, it has been suggested that the developing cognitive function in infants limits the effectiveness of these cognitive and behavioral techniques in regulating their negative emotions (Cohen et al., 2006). In contrast, infants have a mature (developed) function of attentional capture (i.e., automatic attentional allocation toward salient stimuli) (Brosch, Sander, & Scherer, 2007; Thierry, Vihman, & Roberts, 2003), and thus, their attention will be automatically allocated toward salient stimuli in the presence of a stressor. Distraction is an emotion regulation technique that helps to disengage children's attention from negative emotions or negative emotion-evoking stimuli by presenting them appealing stimuli irrelevant to negative emotions (e.g., cartoon movies) and attracting their attention toward the

distractors. Therefore, it may be assumed that distraction can alleviate negative emotions in infants experiencing a stressful medical procedure.

However, few studies have investigated the effects of distraction on negative emotions in infants. Previous studies have reported that distraction using sucking (Field, 1999), breastfeeding (Tansky & Lindberg, 2010), or sugar (Stevens et al., 1997) is efficacious for infants. However, as pointed out by Field (1999), since these distractors cover the mouths of infants, they are unable to communicate their negative emotions in spite of feeling them. To address this methodological limitation, Cohen (2002), Cohen et al. (2006), and Cramer-Berness & Friedman (2005) investigated the effects of distraction on infant negative emotions during immunization using a cartoon as a distractor. However, these studies reported inconsistent results. Cohen (2002) and Cohen et al. (2006) reported that distraction decreases negative behaviors, which are behavioral indexes of negative emotions, in infants, while Cramer-Berness et al. (2005) reported that distraction does not influence these negative behaviors.

These differing results from the previous studies may be attributable to the intensity of the stressor used. Cohen (2002) and Cohen et al. (2006) found that the effects of distraction were apparent during the expectation and recovery phases of injection but not during the administration phase. Because they reported that infants

showed fewer negative behaviors during the expectation and recovery phases than during the administration phase of injection, these results may suggest that distraction may have been efficacious for infants only during the expectation and recovery phases. In contrast, Cramer-Berness et al. (2005) also measured negative behaviors during the expectation and recovery phases, but for shorter periods before and after administration of injection. This may have been one of the reasons for the absence of the effects of distraction in infants. Distractors may automatically capture an infant's attention in the presence of a mild stressor, and thus, distraction may reduce negative behaviors in infants. In contrast, in the presence of an intense stressor, children need to voluntarily inhibit negative stimuli and keep allocating their attention toward distractors for distraction to be successful. Given that infants have limited ability to control their attention (Thierry et al., 2003), they may face difficulty in voluntarily allocating their attention toward distractors, thus inhibiting intensely negative stimuli in the presence of an intense stressor.

Because of a lack of available subjective measures for infants, behavioral and physiological measures have been used to assess emotions in infants. In previous studies of the effects of distraction in infants, negative behaviors of the infants were assessed on the basis of (a) behavioral observation by researchers conducted using video recordings

and (b) subjective ratings of negative emotions provided by nurses and parents based on on-site observation of the infants (Cohen, 2002; Cohen et al., 2006). However, it was consistently observed that data reported by the researchers did not concur with those reported by the nurses or parents (Cohen, 2002; Cohen et al., 2006). The inconsistent results may be attributable to inaccurate evaluation of negative behaviors in infants by nurses and their parents because these behaviors diffuse in medical settings (Cohen, 2002). Therefore, this study used data from behavioral observation by researchers conducted using video recordings instead of on-site subjective ratings by nurses and parents.

Regarding physiological indexes of negative emotions, since physiological arousal is observed without overt negative behaviors (Waters, Matas, & Sroufe, 1975), physiological measures will help capture the subtle arousal of negative emotions in the presence of a mild stressor. Although previous studies used heart rate (Cohen, 2002), it was suggested that heart rate may be a poor index of emotions in infants because of its susceptibility to extraneous variables (Cohen, 2002; Sweet & McGrath, 1998). Thus, the study used salivary α -amylase (sAA) as a physiological index of negative emotions in infants. SAA has been confirmed to be a reliable and valid index of negative emotions in infants (Davis & Granger, 2009). Furthermore, sAA is sensitive to mild stressors in

contrast to other physiological indexes of negative emotions (e.g., cortisol) (Stegeren, Wolf, & Kindt, 2008). For these reasons, sAA is assumed to be an appropriate index for the assessment of negative emotions in infants in the presence of a mild stressor.

The study aimed to investigate the effect of distraction on negative emotions under a mildly stressful medical procedure for inpatient infants. To assess how effectively distraction alleviates negative emotions in infants, we compared the effects of distraction among infants and older children (preschoolers and school-aged children), who have been previously shown to efficaciously regulate their negative emotions using distraction (Cohen, Blount, & Panopoulos, 1997; Dahlquist et al., 2002). First, to confirm whether distraction used in the study was successful, (1) we tested the hypothesis that children would allocate more attention to distractors under a mildly stressful medical procedure. Furthermore, it was hypothesized that infants would show (2) fewer negative behaviors and (3) lower sAA levels under a mildly stressful medical procedure in the presence of a distractor. Furthermore, to assess how effectively distraction alleviates negative emotions in infants, it was tested whether difference would be observed in the effects of distraction among infants and older children under a mildly stressful medical procedure.

Methods

Participants

Fifty Japanese inpatient children (age range, 1–11 years) with hernia or cardiac disease participated in the study (35 boys and 15 girls; mean age, 57.8 months; SD, 33.5; 17 infants (up to 18 months), 14 preschoolers (up to 60 months), and 19 school-aged children (over 60 months)). Children aged up to 18 months were considered as infants for comparison of present study results with those of previous studies (Cohen, 2002). Characteristics among these age groups are shown in Table 1. No differences were observed among infants, preschoolers and school-aged children in terms of gender ($\chi^2(2) = 4.13$, n.s.), and how often they had visited a hospital per month in the past year ($F(2, 47) = 1.45$, n.s.). Data collection was performed at the departments of pediatric surgery or pediatric cardiology in a university hospital in Tokyo, Japan. Children who stayed in the hospital for 2 or 3 days for minor surgery were included in the study. Data were collected on the first and second days of hospitalization. Written informed consents were obtained from all patients' parents and patients aged > 8 years. The study was approved by the local ethics committees.

Measures

Negative behaviors. Monitoring of vital signs, which is a routine medical procedure performed on inpatient children by a nurse, was used as the ‘mildly stressful’ medical procedure. A nurse measured the children’s temperature, heart rate, respiration, and blood pressure in that order, and the total time taken for this analysis in each child was approximately 4 min. Children were examined for vital signs when they were lying on the bed in their hospital room. A research assistant in white clothes held a video camera and recorded the children and nurse during the examination to capture the children’s behaviors and direction of gaze.

A revised version of the scales of triadic interactions during pediatric examinations (STIPE: Kawaguchi, 1997) was used. Items from the original version were modified according to the negative behaviors observed in Japanese children during a stressful medical procedure. STIPE includes 6 subcodes: nervous behaviors, distress behaviors, exploratory behaviors, diverting behaviors, attachment behaviors, and information provision behaviors. This study used ‘nervous’ and ‘distress’ behavior subcodes to capture the children’s negative behaviors. The nervous behavior subcode has three dimensions: repetitive fine movement, upset facial expressions, and stiffen body. The distress behavior subcode has five dimensions: cry, facial expressions of distress, acting up, backing away, and verbal expressions of distress. Furthermore, to

evaluate how children allocated their attention toward a nurse's uniform adorned with attractive character designs, the duration of the children's gaze at the uniform was coded. Coding was started when a nurse arrived at the patient's bedside and told the child that they would be performing an examination of vital signs. Coding was stopped when the nurse told the child that the procedure was completed, i.e., immediately after the blood pressure value was obtained. Two researchers blinded to the study hypotheses independently coded the total duration of the behaviors observed during the examination of vital signs. In accordance with the scoring reported in the study by Kawaguchi (1997), the percentage duration of gaze, nervous, and distress behaviors during the examination generates gaze, nervous, and distress behavior scores, respectively. Because Pearson's correlation coefficients between these coders were 0.85, 0.86, and 0.94 for gaze, nervous, and distress behavior scores, respectively, acceptable inter-rater reliability was confirmed in all participants.

Salivary α -amylase. Salivary α -amylase (sAA) was used as a physiological index of negative emotions. SAA levels increase immediately after stress exposure and reach a peak immediately after the stressor is removed (Davis & Granger, 2009), and thus, saliva was collected immediately after the vital signs were examined. SAA was

measured using an Amylase Monitor (Nipro, Tokyo, Japan). Saliva samples were collected by directly placing a test paper under children's tongues for 30 s. The test paper contains 2-chloro-4-nitrophenyl-4-*O*- β -D-galactopyranosylmaltoside (Gal-G2-CNP) as a substrate for α -amylase. Gal-G2-CNP on hydrolysis by α -amylase produces yellow light, and the reflection ratio is optically measured 20 s after the enzyme reaction. The Amylase Monitor was found to be a reliable and valid tool for measuring sAA (Yamaguchi et al., 2006).

Distraction

Appealing designs (popular animated characters, animated animals, or geometric shapes) on the nurse's uniform were used as distractors. The uniform used as a distraction was a short-sleeved shirt printed with the designs of approximately 10 cm diameter in whole. Under the distraction condition, nurses in uniforms adorned with the designs examined the children for vital signs. They interacted with the children in their usual manner during the examination and were asked not to draw the children's attention specifically to the designs on their uniform.

Nurses choose their uniform among these three kinds of uniform, and were allowed to wear the different kinds another day. Nine nurses examined the one

participating children for their vital signs in the uniform printed with the designs (2 chose the uniforms with animated character designs and 6 chose the uniform with animal designs.) Twelve nurses examined a number of participating children, and 8 nurses wore the same kinds of uniform (2 wore the uniform with animated characters, and 6 wore the uniform with animals), and 4 wore the different kinds (2 wore the uniforms with animated characters and geometric shapes, one wore the uniforms with animated characters and animals, and one wore the uniforms with animals and geometric shapes). Seventeen children were examined by the nurses in the uniform with animated character designs, 28 by the nurses in the uniform with animal designs, and 5 by the nurses in the uniform with geometric shapes.

Usual care

Nurses in a white uniform examined the children for vital signs under a ‘usual care’ condition. Because the nurses interacted with the children in their usual manner during the examination, nurses’ verbal behaviors such as casual conversation with the children, comforting, or information provision about the procedure were not prohibited. However, the nurses were asked to refrain from carrying toys or accessories that could act as possible distractors.

Procedure

Data were collected in the patient's room. The participating children stayed in the hospital for 2 or 3 days for minor surgery, and the data were collected during the examination of vital signs on the first and second days of hospitalization. A nurse examined the vital signs of the children in a uniform with attractive character designs on one day of the 2 days of data collection, and did with a white uniform on the other day; these examinations occurred in a counterbalanced order. Surgery was performed on the second or third day of hospitalization. Data collection on the second day was performed before surgery. Immediately after the examination, a saliva sample was collected. Finally, the parents were asked to complete the questionnaire on the hospital visit frequency per month of their participating children.

Data analyses

To confirm that a uniform with appealing character designs attracts children's attention, a two-way 3 (Age group: Infants, Preschoolers, School-aged children) \times 2 (Intervention: Distraction, Usual care) mixed design analysis of variance (ANOVA) was performed on the gaze behavior scores. To assess the effects of distraction on negative behaviors and

sAA levels among infants, preschoolers, and school-aged children, two-way 3 (Age group: Infants, Preschoolers, School-aged children) \times 2 (Intervention: Distraction, Usual care) mixed design ANOVAs were performed on distress and nervous behavior scores and sAA levels. It is recommended that angular transformation is especially appropriate to percentage data for correcting non-normality (Sokal & Rohlf, 2012). Thus, with respect to the gaze, nervous, and distress behavior scores, angular-transformed data were used for the analyses. However, in the tables, original data are presented in percentage. In addition, to evaluate the differential effects of distraction among infants and older children, effect sizes for negative behaviors and sAA were reported in terms of Cohen's η^2 and Cohen's d for the percentage data (i.e., nervous and distress behavior scores) and means (i.e., salivary α -amylase data), respectively (Cohen, 1988). The significance levels were set at .05 (two-tailed).

Results

Gaze duration

The angular-transformed gaze behavior scores were analyzed by a two-way 3 (Age group: Infants, Preschoolers, School-aged children) \times 2 (Intervention: Distraction, Usual care) mixed design ANOVA (see Table 2). The analysis revealed that the main effects of

Intervention and Age group were significant (Intervention: $F(1, 47) = 22.11, p < .01$; Age group: $F(2, 47) = 3.30, p < .05$). Multiple comparison revealed that infants looked at a nurse's uniform longer than school-aged children. These results indicate that children allocated more attention toward a nurse's uniform with character designs than toward a nurse's white uniform.

Negative behaviors

The angular-transformed nervous and distress behavior scores were analyzed by two-way 3 (Age group: Infants, Preschoolers, School-aged children) \times 2 (Intervention: Distraction, Usual care) mixed design ANOVAs (see Table 3). Regarding nervous behaviors, the analysis revealed a significant main effect of Intervention ($F(1, 47) = 4.93, p < .05$, Cohen's $d = 2.11$). Regarding distress behaviors, the analysis revealed a significant trend in the main effects of Intervention and Age group (Intervention: $F(1, 47) = 2.92, p < .10$, Cohen's $d = 2.20$; Age group: $F(2, 47) = 2.80, p < .10$). These results may suggest that distraction was associated with fewer negative behaviors.

Salivary α -amylase

Three infants (one male and two females) and a male preschooler were deleted from the

analysis for sAA, because they hated to place a test paper under their tongues and their data for sAA levels could not be obtained. SAA levels were analyzed by a two-way 3 (Age group: Infants, Preschoolers, School-aged children) \times 2 (Intervention: Distraction, Usual care) mixed design ANOVA (see Table 4). The analysis revealed that the main effects of Intervention and age group were significant (Intervention: $F(1, 43) = 5.20, p < .05$, Cohen's $d = 0.37$; Age group: $F(2, 47) = 3.26, p < .05$). Multiple comparison revealed that infants showed higher sAA levels than school-aged children. This result indicates that distraction was associated with lower sAA levels for children.

Discussion

The study aimed to investigate the effects of distraction on negative emotions associated with medical procedures in inpatient infants. The following hypotheses were tested: (1) children would look at a nurse's uniform with attractive character designs for longer periods, (2) children would show fewer negative behaviors during examination of vital signs when distracted, and (3) children would show lower sAA levels immediately after the examination of vital signs under the distraction condition. Furthermore, to assess how effectively distraction alleviates negative emotions in infants, it was tested whether difference would be observed in the effects of distraction on negative behaviors and

sAA levels among infants, preschoolers, and school-aged children.

Consistent with hypothesis 1, children looked at a nurse's uniform with attractive designs longer than that at a nurse's white uniform. This result supports the validity of distraction caused by a nurse's uniform with the designs. Regarding negative behaviors, in line with hypothesis 2, children showed fewer nervous or distress behaviors, when distracted. Regarding sAA, children showed lower sAA levels immediately after the vital signs were examined under the distraction condition, and these results support hypothesis 3. Furthermore, no difference would be observed in the effects of distraction on negative behaviors and sAA levels among infants, preschoolers, and school-aged children. The results would suggest that distraction can alleviate infant negative emotions under a mildly stressful medical procedure as with older children. Considering the shorter duration of negative behaviors and lower sAA levels in school-aged children, monitoring of vital signs used as a mild stressor in the study may be too mild for school-aged children and they may not have experienced few negative emotions. Thus, it may make it difficult to compare the effects of distraction of infants with those of school-aged children. Although previous studies on the effects of distraction on infants reported inconsistent results (Cohen, 2002; Cohen et al., 2006; Cramer-Berness et al., 2005), the present findings suggest that consistent effects of

distraction on infants may be obtained at least in the presence of a mild stressor. It is reported that intervention by clown doctors that attracts children undergoing minor surgery could reduce preoperative negative emotional responses in children (Dionigi et al., 2013; Fernandes & Arriaga, 2010), and the present results are in line with these findings.

As indicated by the result of the longer duration of gaze at a nurse's uniform with character designs, children's attention is allocated toward the designs on the uniform, which may result in reducing attention allocation toward negative emotions or negative emotion-evoking stimuli. In this mechanism, distraction may be associated with fewer negative behaviors and lower sAA levels in the presence of the mild medical procedural stressor.

Furthermore, it is worth noting that the effects of distraction on infants and preschoolers were apparent in different indexes as follows: distraction was associated with distress behaviors and sAA levels in infants, nervous behaviors and sAA levels in preschoolers. This may be because infants showed increased distress behaviors and sAA levels during the medical procedure in the absence of distraction, while they showed few nervous behaviors. Regarding preschoolers, negative responses emerged in nervous behaviors and sAA indexes but not in a distress behavior index. Older children inhibit

overt negative behaviors (Waters et al., 1975), and thus, these results may be consistent with those of previous observations. Because indexes that are sensitive to mild arousal of negative emotions may be different among the age groups, the effects of distraction may be detected in different indexes among the age groups.

The nurse's uniform with appealing designs used as a distraction successfully attracted infants' attention. Infants have a premature attentional control, while they have a mature (developed) function of attentional capture (Brosch et al., 2007; Thierry et al., 2003). Attentional capture is related to automatic detection of salient stimuli, and attentional control is related to voluntary maintenance of fixation on or disengagement from the once attended stimuli (Bundesen & Habekost, 2008; Hopfinger et al., 2000). Thus, mature attentional capture will facilitate detection of appealing designs on the nurse uniform, although attention may be more subject to be disengaged from the stimuli due to premature attentional control. Additionally, infants' attention tends to be allocated toward intricately shaped stimuli, especially facial stimuli (Fanz, 1966). Therefore, the uniform designs used as a distractor will attract infants' attention. In addition, the location of a distractor may increase the effects of distraction caused by the nurse's uniform. Infants are likely to look at nurses during stressful medical procedures (Cohen, 2002). Because the nurses wore a uniform with distractors in the study, infants

might look at them more frequently during stressful medical procedures. Furthermore, from a practical point of view, it was suggested that psychological interventions for inpatient children need to be natural and cost-effective and should not affect the original illness in medical settings (Tansky & Lindberg, 2010). Distraction caused using a nurse's uniform with character designs meets these demands. For these reasons, the nurse's uniform with character designs may be an efficacious tool for distracting infants undergoing mildly stressful medical procedures.

The study has several limitations. First, no previous study has used a nurse's uniform with attractive character designs as a distractor. Thus, the validity of the nurse's uniform as a distractor has not been confirmed. However, since the present study has confirmed that the nurse's uniform with character designs attracts children's attention, this may support the validity of the nurse's uniform as a distractor. Second, it may be possible that the effects of distraction are moderated by stressor quality as well as stressor intensity. An injection used as a medical procedural stressor in previous studies (Cohen, 2002; Cohen et al., 2006; Cramer-Berness & Friedman, 2005) elicits pain for a moment. In contrast, an examination for vital signs used as a mild stressor in the present study includes physical contact with strangers but for a longer duration. Thus, future studies need to investigate these potential moderators of stressor quality.

In conclusion, distraction was associated with fewer negative behaviors and lower sAA levels with distraction under a mildly stressful medical procedure in children, and no difference was observed in the effects of distraction on negative behaviors and sAA levels among infants, preschoolers, and school-aged children. The results suggest that distraction could alleviate negative emotions in infants as well as older children in the presence of a mild medical procedural stressor. Although there is reported no evidence for the distracting effects of a nurse's uniform with character designs, the present study showed that the nurse's uniform with character designs attracts children's attention. Therefore, it may act as another tool to be used for distracting infants.

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Table 1. Characteristics of each age group.

	Infants (<i>n</i> = 17)		Preschoolers (<i>n</i> = 14)		School-aged children (<i>n</i> = 19)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Age (month)	25.47	7.57	48.36	7.50	93.79	23.08
Boy/Girl	9/8	–	12/2	–	14/5	–
Hospital visit frequency per month	0.89	0.87	1.05	1.86	0.38	0.58

Table 2. Means and standard deviations for the percentage duration of gaze behaviors (%).

	Infants (<i>n</i> = 17)		Preschoolers (<i>n</i> = 14)		School-aged children (<i>n</i> = 19)	
	Distraction	Usual care	Distraction	Usual care	Distraction	Usual care
<i>M</i>	9.26	2.83	6.79	1.32	3.62	2.42
<i>SD</i>	7.23	3.11	8.24	0.96	6.13	3.77

Table 3. Means and standard deviations for the percentage duration of nervous and distress behaviors (%).

	Infants (<i>n</i> = 17)		Preschoolers (<i>n</i> = 14)		School-aged children (<i>n</i> = 19)	
	Distraction	Usual care	Distraction	Usual care	Distraction	Usual care
<i>Nervous behaviors</i>						
<i>M</i>	1.67	1.75	0.09	4.36	0.37	1.25
<i>SD</i>	2.91	2.64	0.22	8.91	1.06	2.47
<i>Distress behaviors</i>						
<i>M</i>	1.46	6.06	1.49	2.90	0.00	0.01
<i>SD</i>	3.95	12.94	5.36	9.01	0.00	0.05

Table 4. Means and standard deviations for salivary α -amylase levels (U/mL).

	Infants (<i>n</i> = 17)		Preschoolers (<i>n</i> = 14)		School-aged children (<i>n</i> = 19)	
	Distraction	Usual care	Distraction	Usual care	Distraction	Usual care
<i>M</i>	56.71	92.36	49.46	71.85	40.32	41.89
<i>SD</i>	35.87	81.71	27.17	48.89	31.87	25.89