



Music as an alternative self-regulation strategy to snack foods following a negative mood induction in 5-7-year-old children: Interactions with parental use of food as a reward

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ABSTRACT

This study aimed to extend studies that have looked at snack food consumption following a negative mood induction, and examine whether listening to a happy song would counteract these effects in children. A second aim was to examine whether parental feeding practices (use of food as a reward and the use of food to regulate emotions) and child Body Mass Index (BMI) would moderate any differences. Eighty 5-7-year-old children took part in a negative mood induction and were then assigned to either a happy music condition or a silent control condition. The weight (g) consumed of four snack foods was measured (fruit hearts, crisps, chocolate biscuits, and breadsticks). Parents filled in baseline measures of feeding practices. There were no significant differences in food consumption between conditions. There was, however, a significant interaction between the high use of food as a reward and the condition on the amount of food eaten. In particular, following a negative -mood induction, those children whose parents reported using food as a reward and who were in the silent condition ate significantly more snack foods. There were no significant interactions with child BMI or with parental use of food to regulate emotions. This research suggests that the use of certain parental strategies may influence how children respond to novel emotion regulation techniques. Further research is needed to evaluate the best types of music to regulate emotions in children, and whether parents can be encouraged to replace maladaptive feeding practices with more adaptive non-food practices.

1. Introduction

1.1. Emotional eating

Obesity is a serious health problem in children, with one-third of children aged 2–15 years in the United Kingdom (UK) classified as meeting the criteria for this BMI category (Johnson et al., 2015). In addition, up to 27% of 5-year-old children in the UK are reported to eat more in response to emotions, which is known as emotional eating (Webber et al., 2009). Emotional eating describes the tendency to overeat in response to experiencing heightened emotional states, that may be negative such as stress, sadness, boredom, or positive such as happiness (Bongers et al., 2013; Evers et al., 2010; Tan & Holub, 2018). Such overeating often occurs in the absence of hunger (Crockett et al.,

2015; Reel & Ebrary, 2013) and involves highly palatable, nutritionally poor snack foods, such as chocolate, crisps, and biscuits (Evers et al., 2018; Greeno & Wing, 1994; Nguyen-Rodriguez et al., 2008). Highly palatable foods are often referred to as comfort foods, implying that they have an emotion regulation function (Evers et al., 2010). The behaviour of emotional eating in children has been linked to a higher Body Mass Index (BMI) and puts children at risk for developing obesity (Webber et al., 2009).

A variety of theories have been developed to explain emotional overeating as a way of coping with negative emotions. It has been found that emotional eating is largely determined by the environment rather than genetic contributors. This suggests it is one of the few eating behaviours linked to overweight and obesity that can be modified through the environment (Herle et al., 2018). The Affect Regulation Model suggests

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that people who emotionally overeat do so in response to negative affect because they have learned that it alleviates aversive mood states (Telch & Agras, 1996). The Escape Theory suggests that emotional eating is an attempt to escape or shift attention away from negative self-awareness caused by negative affect (Heatherton & Baumeister, 1991). It has also been argued that emotional eating can increase positive emotions in those who enjoy the sensory experience of eating (Lutter & Nestler, 2009) and that people who engage in emotional eating tend to ignore physiological cues of hunger and fullness when they experience heightened negative emotional states (Reel & Ebrary, 2013).

Emotional eating is not a disorder, but rather a maladaptive behaviour that has been shown to exist along a continuum of severity (Snoek et al., 2007). Emotional eating can be considered a maladaptive coping strategy as it does not address any underlying causes of negative affect, meaning that it can lead to a vicious circle of repeated episodes (Spoor et al., 2007). Moreover, despite emotional eating providing short-term improvements in mood, regular habitual use of food to regulate emotions can lead to overeating and weight gain (Macht & Mueller, 2007). Emotional eating has been evidenced across the lifespan, in adults, adolescents, and even in preschool children (Knutz et al., 2015; Michels et al., 2012; Spoor et al., 2007). There is some emerging evidence that these emotional eating behaviours are taught in early childhood as a consequence of parental feeding practices, such as using food as a reward, or to regulate emotions (Farrow et al., 2015).

1.2. Emotional eating in childhood

Emotional eating is believed to be largely determined by elements in the environment as opposed to genetic factors (Herle et al., 2018). Blissett et al. (2010) examined emotional eating in children aged 3–5 years old and found that high parental use of food for emotion regulation, such as giving snack foods to their child when they were upset, led to higher consumption of chocolate in a negative mood versus a neutral control condition. They manipulated mood using a negative mood induction procedure, where children were promised a toy if they were able to complete a jigsaw puzzle (which was an impossible task as it had a piece missing). Farrow et al. (2015), conducted a follow-up study with the same sample to test whether parental feeding practices (restriction, pressure to eat, use of food as a reward and use of food for emotion regulation) were associated with child emotional eating behaviours two years after the initial measurements. In this later mood induction study, children were given an impossible colouring task (with a missing colour crayon) to obtain a prize. Farrow et al. (2015) found that the greater the reported use of food as a reward, defined as rewarding the child with palatable snack foods for good behaviour, the greater the food intake following this negative mood induction. These findings are in line with research that shows that parents play an important role in teaching their children emotion regulation skills based on food (Bariola et al., 2011).

Although there has been little research to examine the mechanisms behind the use of these two different (but associated) feeding practices, it is possible that they work in different ways to embed later emotional eating. By giving food as a reward, parents are creating associations between foods and positive experiences. This type of strategy may map onto the Escape Theory (Heatherton & Baumeister, 1991), as people respond to negative situations by seeking out strategies that provide positive associations and immediate distraction. In contrast, using food as an emotional regulator more explicitly teaches children to regulate their emotions through the use of food as a comfort and distraction. Parents are emotional regulation role models and children are likely to show similar emotional regulation techniques to them (Bariola et al., 2012). Explicit teaching of using food to regulate emotions fits in with the Affect Regulation Model of emotion regulation (Telch & Agras, 1996).

1.3. Countering emotional eating with music

Listening to music and eating unhealthy foods have some common features relevant to emotion regulation. In particular, both can be increased in response to negative emotions and both can immediately improve mood (Carlson, 2014; Koelsch, 2010; Morris & Reilly, 1987; Randall & Rickard, 2017; Van Goethem & Sloboda, 2011). Unlike consuming palatable food which provides calories and nutrients, music listening does not provide an overt physiological function in the body. Neuroimaging studies, however, show the activation of emotion, reward, motivation, and arousal networks during music listening (Blood & Zatorre, 2001; Gold et al., 2019; Salimpoor et al., 2011). As a result, exposure to music might be well-suited to help children (and adults) avoid emotional eating.

Laboratory research has already found that music listening reduces the impact of negative mood on unhealthy eating among adults (Van den Tol et al., 2022). Participants were either given a sadness induction (writing about a recent sad event) or a stress induction (solving impossible anagrams). Participants ate an average of 25 g of snacks when no music was played, while this was approximately halved when listening to certain types of music. Which type of music listening strategy was most effective depended on the type of mood manipulation. For sadness inductions, music for solace (i.e., calming music) or discharge (i.e., sad or angry music) led to lower snack food consumption. For stress inductions, music for solace led to less emotional eating. These experiments suggest that music may be an effective alternative mood-regulation technique to eating. Information about the value of music to reduce emotional eating may also be beneficial in teaching children healthy emotion regulation skills. Adaptive emotion regulation skills are primarily learned in childhood (Calkins & Hill, 2007, p. 229248) from parents and other caregivers (Bariola et al., 2011, 2012; Calkins & Hill, 2007, p. 229248; Classen & Thompson, 2016; Nguyen-Rodriguez et al., 2008; Reijntjes et al., 2007; Zeman et al., 2006). These caregivers play an active role in children's development of emotion regulation skills by co-regulating their emotions (where caregivers help to regulate the emotions for a child), but also through more explicit teaching (such as when a child is being told about the importance of relaxation or downtime) or by modelling potential strategies (observing how caregivers regulate their own moods) (Classen & Thompson, 2016; Schlesier et al., 2019; Spinrad et al., 2007).

Evidence of music listening for emotion regulation has been found in adults, adolescents, and children (Hanser et al., 2016; Randall & Rickard, 2017; Saarikallio et al., 2015; Sloboda et al., 2009; Van den Tol & Giner-Sorolla, 2016, 2022; Van Goethem & Sloboda, 2011). Young children frequently enjoy musical activities at home, in preschool, and in daycare settings (Levy et al., 1989; Marsh & Young, 2006, pp. 289–310; Sloboda et al., 2009). While this music serves a variety of different functions (such as language development) there is also ample evidence of parents and caregivers regulating the moods of young children with music (Cho & Ilari, 2021; Ilari et al., 2011; Van den Tol et al., 2021). Cho and Ilari (2021) provided mothers of 18 months to 5-year-old children with a variety of playlists aimed at achieving moods (e.g., lively, calm, and upset), and asked them to report on their use of these playlists for a week. Findings indicated that music could fulfil various emotional needs including maintaining or reinforcing a child's positive mood and improving negative moods, with certain playlists being used more commonly for uplifting moods and others functioning more commonly to calm children down. Similarly, earlier qualitative research (Ilari, 2005; Ilari et al., 2011) has found that most mothers use their infant's mood as an indicator of when to use music with certain musical features. The importance of music in children's emotion regulation is in line with pre-schoolers already being able to distinguish basic emotions, such as happiness, sadness, anger, and fear, and identify them in music (Stachó et al., 2013). To conclude, music might be an important emotional regulation tool to alleviate negative feelings in children.

1.4. The current research

Emotional eating is common in children and has been associated with being at risk for overweight or obesity (Webber et al., 2009). There is a need to build on existing knowledge in this area, to understand both emotional eating and possible strategies for reducing it. In adults, listening to music can reduce emotional eating after a negative mood induction (Van den Tol et al., 2022). Therefore, music has the potential to play an important role in child emotion regulation, however, no research has examined whether music exposure can reduce emotional eating in children.

It is known that parental feeding practices are associated with higher emotional eating in children, such as high use of food as an emotional regulator (Blissett et al., 2010) and high use of food as a reward (Farrow et al., 2015). Research shows that parental use of food as a reward predicts child BMI (Jansen et al., 2020). There is no research that examines the use of these feeding practices in relation to non-food emotional regulation practices, and whether there is the potential for replacing food-based strategies for rewarding behaviour and regulating emotions, with more adaptive techniques.

The first aim of the current study was to ascertain whether listening to music (or not) can lower snack food consumption in children following a negative mood induction. The second aim of the study was to investigate whether child BMI and parental feeding practices (use of food for emotional regulation and use of food as a reward) can moderate the outcomes.

2. Method

2.1. Participants

Participants consisted of eighty children aged 5–7 years ($M = 5.99$, $SD = 0.69$; 36 males, 44 females), who were recruited from two primary schools in the East Midlands, UK. Exclusion criteria at recruitment were children who had food allergies or those who followed a dairy-free diet (e. g. vegan or lactose intolerance). Parents of children in years 1–2 (aged 5–7 years) were given an information sheet and questionnaire pack ($n = 120$). The children of those parents who returned the packs ($n = 80$) were tested.

2.2. Research design

A between-subjects design was adopted to examine the effect of music versus silence on the amount (in grams) of palatable snack foods consumed. The four snack foods were chocolate biscuits, crisps, breadsticks, and fruit hearts. The main experimental factor was the condition (music versus silence), to which the child participants were randomly allocated using random number generation. There were three further factors which were quasi-experimental and calculated by using a median split (high and low scorers). These were child BMI (high versus low), parental use of food as a reward (high versus low), and parental use of food to regulate emotions (high versus low). Possible covariates that were measured were baseline hunger, mood ratings at three time points (happy-unhappy) and liking of the four foods presented.

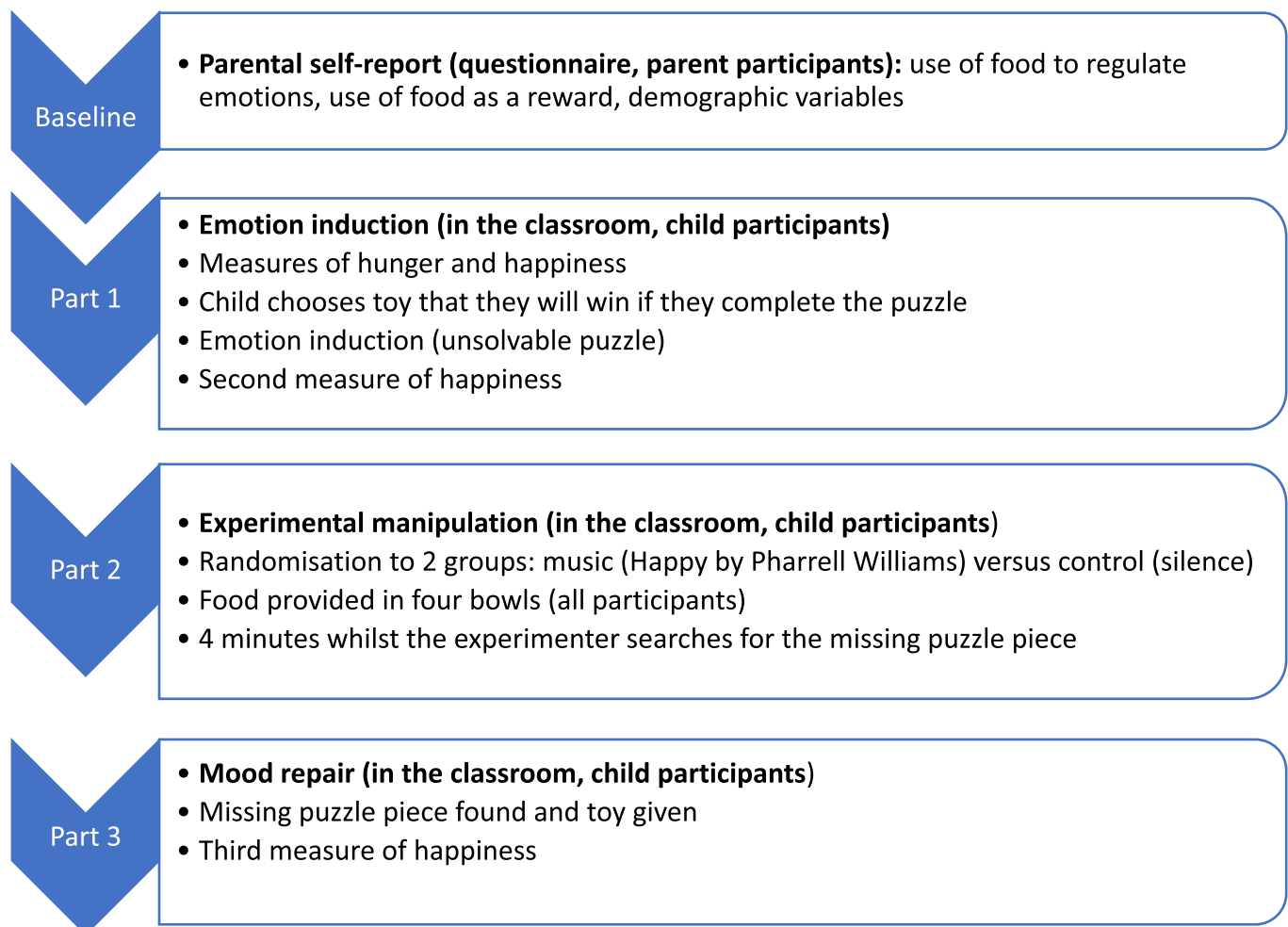


Fig. 1. Flowchart of experimental procedure.

2.3. Experimental procedure

Ethical approval for this study was granted by the University Research Ethics Committee (HLS FREC: 2045), and the study used informed consent for parents and verbal assent to a pictorial information sheet for child participants. The entire research procedure/activity lasted approximately 15 min for each child and took place within the school in a separate room away from the other children to avoid distractions (see Fig. 1 for a flow diagram of the experimental procedure). The experiment took place after lunchtime to ensure children were eating in the absence of hunger throughout the experiment. The procedure was based on Blissett et al. (2010) who examined whether a negative mood induction versus no mood induction would lead to the greater consumption of snack foods. This original design was altered; in this study, all children experienced the negative mood induction, and whether the child listened to music versus silence was the main experimental manipulation.

2.3.1. Baseline: parental self-report

Parents were asked to fill in the consent form, demographics questionnaire, and report parental feeding practices prior to the child taking part in the study.

2.3.2. Part 1: Emotion induction

On entering the room, children's height and weight measurements were taken. They were then asked to sit down and rate their hunger and mood. The child was given a jigsaw puzzle to complete and chose a prize they would win if they successfully completed it. The jigsaw puzzle (Peppa Pig, 12-piece suitable for ages 3+) had a piece missing. The researcher stated, 'Here is a jigsaw puzzle. If you complete this, you can choose one of these prizes'. The child was shown the prizes and asked which one they would like to have. The prizes for completion of the experiment consisted of either, a bouncy ball, eraser, pen, or plastic key ring. After the child realised that there was a piece of the puzzle missing the researcher stated; 'Oh dear, you haven't completed it so you can't get a prize'. The child re-rated their mood on the mood rating scale. This negative mood induction procedure was adapted from research by Blissett et al. (2010).

2.3.3. Part 2: Experimental manipulation

The children were randomised into one of two conditions; music versus silence. In both conditions the researcher placed four bowls in front of the child (one bowl for each of the four snacks). While doing this the researcher said; 'Here are some snacks to eat whilst I look for the missing piece'. The child was asked to rate their liking of the four foods on a five-point scale. At this point in time, the child was left with the snacks for 4 min and the main experimental manipulation took place; in the music condition, the song 'Happy' was played through, a speaker, and in the silent condition a silent timer was set to 4 min.

2.3.4. Part 3: Mood repair

Once the music had finished/the timer buzzed, the researcher returned to the child and said 'Oh look, I have found the missing piece, you can have a prize now'. The child was asked to rate their mood for the final time. The researcher showed the child the mood rating scale and then the child was offered the prize they selected.

2.4. Measures

2.4.1. Demographic variables

In order to describe the sample, parents were asked to report several demographic variables within the self-report questionnaire. These were parental age (years), sex (male, female, other/prefer not to say), highest educational qualification (primary school, secondary school, college, university degree, postgraduation qualification), and ethnicity (White-British, White-European, Black-British, Black-Caribbean, Black-African,

British-Asian, Asian-other, Mixed Heritage, other, prefer not to say). Child demographic variables were child age (years) and sex (male, female, other/prefer not to say).

2.4.2. Parental feeding practices (Comprehensive feeding practices questionnaire (CFPQ), Musher-Eizenman & Holub, 2007)

The CFPQ has been widely used to assess parental feeding practices of children from as young as three years old (Blissett et al., 2010; Doaei et al., 2015; Farrow et al., 2015; Salarkia et al., 2016). The original CFPQ evaluates child feeding styles on 12 subscales, each consisting of 3–8 items. In the present study, two subscales of the CFPQ were used: Food for emotional regulation (3 items), for example, 'I give my child sweets when they are fussy' (in the present study $\alpha = 0.80$) and food as a reward (3 items), 'I offer sweets as a reward for good behaviour' Cronbach's ($\alpha = 0.65$, in the present study which was deemed acceptable).

2.4.3. Child Body Mass Index (BMI)

Digital weighing scales (Seca 877) which had a maximum capacity of 200 kg and a sensitivity of 10 g were used to measure the weight of the children in kilograms. An upright height measure (Leicester Portable Height Measure) with a sensitivity of 1 mm (mm) increments was used to measure the height of the children in metres (m). Children were measured in their clothes with shoes removed. Body Mass Index (BMI) was calculated as BMI percentiles which controlled for the age and sex of the child (McCarthy et al., 2006).

2.4.4. Mood and hunger ratings

2.4.4.1. Mood rating scale. Mood of the child participants was measured, by the researcher on a five-point smiley face scale, with the instructions 'Can you point to the smiley face that shows how happy or sad you are feeling right now?'. This type of scale is well used in research with children of this age (Gummer et al., 2020; Hall et al., 2016; Stange et al., 2018). Mood was measured in this way at three time points; (1) At baseline, (2) after the negative mood induction, and (3) after the food and music condition.

2.4.4.2. Hunger rating scale. A modified three-point version of the Teddy Bear Rating Scale, with three bears was used to assess hunger (Bennett & Blissett, 2014). A paper sheet with three teddy bears whose stomachs contained three different-sized black ovals to represent fullness (large, medium, small) was presented to the child participant. The researcher asked, 'Can you point to the teddy bear that shows how hungry you are? Are you very hungry, a little hungry, or not hungry at all?'. Hunger was rated on a three-point scale from 3 (very hungry) to 1 (not hungry at all/very full).

2.4.5. Experimental music

The class teachers were asked to identify a song that was well-liked by the children, and used in assembly and the classroom as a treat. They decided that 'Happy' by Pharrell Williams was liked and positively viewed by the children, and so this was used as the music track to be played in the experimental condition. In the silent condition, a silent timer was used which buzzed at the end of 4 min. Both conditions were timed to last for 4 min.

2.4.6. Experimental foods (consumption and liking)

Manufacturer nutritional labels were used to determine the calories contained in each pack of food. The experimental foods in this experiment were: Crisps ('Pom Bears' weighing 15 g and containing 79 calories per pack), chocolate biscuits ('Cadbury mini animals' weighing 22 g and containing 105 calories per pack), breadsticks ('mini breadsticks by Sainsbury's' weighing 20 g & containing 80 calories per pack) and fruit hearts ('The fruit factory strawberry fruit hearts' weighing 18 g & containing 56 calories per pack) which were individually packaged. New

disposable paper bowls were used for each child and any food leftover was thrown away along with the bowls that were used.

2.4.6.1. Food consumption. The weight of each food eaten was recorded in grams (initial weight of food minus final weight of food). The food was weighed using food weighing scales (Seca 852 scales, with a sensitivity of 1 g).

2.4.6.2. Food liking. Children rated how much they liked each food on a five-point scale from 5 (like a lot) to 1 (really not liked). The question stated; ‘How much do you like this food?’. This was done when the food bowls were first placed in front of them prior to consumption.

2.5. Data analysis

2.5.1. Preliminary analysis

All statistical analyses are reported with two-tailed levels of significance unless otherwise stated and with alpha set at $p < .05$. P-P plots tests and descriptive statistics showed that demographic data, feeding practices, children’s mood rating at all three phases, hunger rating, and snacks consumed were normally distributed, so parametric statistics were carried out. To determine whether the negative mood induction was successful a mixed 2x3 ANOVA was conducted in which time 1, time 2, and time 3 were the within-subject factors, the condition was the between-subject factor, and mood was the dependent variable.

Independent sample t-tests were used to test for possible covariates by examining possible baseline differences between the music and silence conditions. The baseline continuous variables were parental age, child age, parental feeding practices, baseline child hunger, and child BMI. Chi-square tests were used to examine differences in parent sex, parental education, parental ethnicity, and child sex. Any differences were entered into subsequent analyses as covariates.

2.5.2. Main analysis

To test the hypothesis that music listening can reduce food consumption in children who have been exposed to a negative situation, a series of one-way ANCOVA were conducted to examine differences in food consumption and liking between the two conditions. Hunger was entered as a covariate to ensure that the outcomes were measuring eating in the absence of hunger. A further series of 2x2 ANCOVA was carried out to examine interaction effects between 2 factors; group (music condition versus silence condition) and feeding practices/BMI (high versus low). In each ANCOVA the dependent variable was either the total grams consumed or the grams consumed for each different food (one different food for each ANCOVA). All ANCOVA controlled for liking of the food (as there was a difference in liking of chocolate biscuits between the conditions) and hunger. As many children ($n = 32$) did not report a negative mood after the mood induction, these ANCOVA were also additionally performed as ANCOVA controlling for the mood score after the induction as a covariate, and any differences after adjustment were noted as footnotes under [Table 4](#).

3. Results

3.1. Baseline differences between the conditions

[Table 1](#) represents the demographic characteristics and baseline variables according to the condition. Most of the questionnaires were filled in by the child’s mother and nearly half (45%) of parents reported that their highest level of education achieved was at a degree level.

Half of the parents (50%) reported their ethnicity as Black-British, Black-African, or Black-Caribbean ($n = 40$), 23.38% ($n = 19$) reported to be White-British or White-European, 12.5% ($n = 10$) reported to be British-Asian, 10% ($n = 8$) reported to be Mixed Heritage, and 3.75% ($n = 3$) selected ‘other’ for their ethnicity. It was found that there were no

Table 1

Differences in demographic and baseline variables between the two conditions (music versus silence) in 5-7-year-old school children.

	Music condition (n = 40)	Silence condition (n = 40)	Total (N = 80)
Parental Age M (SD)	37.56(5.29)	35.98(5.87)	36.76 (5.61)
Parental education			
Degree or higher (%)	22(55%)	14(35%)	36(45%)
Parental sex			
Female n (%)	31(78%)	35(88%)	66(83%)
Child sex			
Female n (%)	20(50%)	24(60%)	44(55%)
Childs Age M (SD)	5.98(0.70)	6.00(.68)	5.99(.68)
Child BMI percentile	63.30(30.21)	55.60(32.69)	59.45 (31.51)
M (SD)			
Emotional feeding M (SD)	2.23(0.88)	2.14(.71)	2.18(.80)
Food as a reward M (SD)	2.93(0.84)	2.98(.69)	2.95(.76)
Hunger rating M (SD)	1.90(0.78)	1.95(.71)	1.93(.74)

baseline differences between the two conditions (music versus. silent) on any of the baseline variables (demographic, hunger, parental feeding practices, and child BMI).

3.2. Effectiveness of the negative mood induction

The happiness ratings at three points across the two conditions are presented in [Table 2](#). Mauchly’s test was significant ($p < .001$), so analyses were adjusted using a Greenhouse-Geisser correction. There was a significant difference between mood ratings at baseline, after the negative mood induction and after the food consumption in the sample as a whole, $F(1.48, 114.42) = 46.45, p < .001, \eta_p^2 = 0.38$. Post hoc tests revealed that the children were less happy after the negative mood induction compared to baseline ($p < .001$) and after food consumption ($p < .001$). There was no difference in happiness rating between baseline and after food consumption ($p = .63$). There was no interaction between the conditions and mood ratings, $F(1.49, 114.42) = 1.15, p = .27$, suggesting there was no additional effect of music on the child’s rated happiness.

3.3. Differences in variables according to the experimental condition (music versus no music)

Most of the differences between the two conditions (music versus silence) on food liking or consumption variables were not significant (see [Table 3](#)). There was, however, a difference in chocolate biscuit liking between the two conditions, with liking being greater in the silent condition than in the music condition. Liking was therefore entered as a covariate in all the subsequent analyses.

3.4. Interactions between parental strategies, BMI, and the condition on the amount of food consumed

There were no differences in the amount of food eaten, in any of the

Table 2

Differences in happiness ratings during the experiment between the music and silence conditions.

	Happiness 1 (baseline)	Happiness 2 (after mood induction)	Happiness 3 (after food)
Music	4.75(0.75)	3.47(1.36)**	4.68(0.62)
Silence	4.87(0.41)	3.74(1.35)**	4.72(0.61)
Total	4.81(0.61)	3.61(1.35)**	4.70(0.61)

Note: 5 = Very Happy, 4 = Happy, 3 = Neutral, 2 = Unhappy, 1 = Very Unhappy, $p < .001$ **.

Table 3
Differences in food consumption and liking variables between the two conditions (music versus silence) in 5-7-year-old school children.

	Music (n = 40)	Silence (n = 40)	Total (N = 80)	t	p
Liking rating crisps	4.22 (1.25)	4.25(1.10)	4.23(1.18)	-0.10	.93
Liking rating chocolate biscuits	4.25 (1.01)	4.68(0.76)	4.46(0.92)	-2.13	.04
Liking rating fruit hearts	4.43 (1.08)	4.36(1.01)	4.39(1.04)	0.28	.78
Liking rating breadsticks	3.78 (1.44)	3.93(1.51)	3.84(1.47)	-0.46	.65
Crisps eaten (g)	2.58 (2.70)	2.87(2.68)	4.02(0.59)	-0.50	.62
Fruit hearts eaten (g)	5.90 (5.74)	6.48(5.96)	7.24(1.18)	-0.44	.66
Chocolate biscuits eaten (g)	6.15 (6.93)	7.28(6.06)	6.91(1.18)	-0.77	.44
Breadsticks eaten (g)	2.75 (3.37)	3.50(3.79)	3.62(0.89)	-0.93	.35
Total amount eaten (g)	17.37 (13.0)	20.13 (11.38)	18.75 (12.25)	-1.00	.32

Note: 5 = Liked a lot, 4 = Liked a little, 3 = Neutral, 2 = Not liked much, 1 = Not liked at all.

ANOVAs in which emotional feeding groups (high versus low) and BMI (high versus low) were used as factors. The use of food as a reward (high versus low) did interact with the condition (music versus silence) on crisp, fruit heart, and breadstick consumption, but not chocolate biscuit consumption. In all analyses, consumption was higher in those children whose parents reported a high use of food as a reward and who were in the silence condition (see Table 4).

4. Discussion

4.1. Overview of findings

This study aimed to explore the impact of music on snack food consumption of children exposed to a negative mood induction. It was particularly focused on whether listening to happy music after a negative mood induction would lead to decreased consumption of high fat, high sugar snack foods. The findings from this study did not support the main hypothesis which stated that the children who listen to happy music when being in a negative mood will eat less food after controlling for hunger. In addition, we aimed to explore whether there were any interactions between the condition (music versus silence) and parental feeding practices or child BMI on food consumption. It was found that there was an interaction between parental use of food as a reward and the condition (music versus silence) on food intake. In particular, those children whose parents used food as a reward, and who were in the silent condition, had a higher intake of unhealthy snack foods. This was true for most of the experimental foods (fruit hearts, crisps, and breadsticks), but not for chocolate biscuits. There was a main effect of use as food as a reward (high versus low) on the consumption of fruit hearts, with those

Table 4
Interactions between using food as a reward and the condition (music versus silence) on the amount of food eaten.

	High use of food as a reward (n = 42)		Low use of food as a reward (n = 38)		Main effect of food as a reward			Condition *food reward groups		
	Music	Silence	Music	Silence	F	p	η_p^2	F	p	η_p^2
Crisps eaten (g)	1.29 (1.96)	3.00 (3.00)	3.25 (2.81)	2.74 (2.35)	2.33	.13	.030	4.69	.03	.059
Fruit hearts eaten (g)	5.82 (6.53)	9.81 (6.11)	5.96 (5.24)	2.78 (2.86)	7.77	.01	.09	8.65	.004	.103
Chocolate biscuits eaten (g)	5.59 (7.66)	6.71 (6.37)	6.57 (6.49)	7.89 (5.80)	0.32	.58	.004	0.001	.97	.000
Breadsticks eaten (g)	1.71 (3.22)	4.67 (4.19)	3.52 (3.34)	2.21 (2.90)	0.30	.59	.004	7.70	.007	.09
Total eaten (g)	14.41 (11.43)	24.19 (12.57)	19.57 (14.00)	17.79 (11.71)	.62	.43	.008	6.81	.01	0.08

Note: All analyses controlled for baseline hunger and food liking. Additional analyses controlled for mood after the induction as a covariate led to the same pattern of findings.

children whose parents reported using high levels of food as a reward eating more fruit hearts regardless of the condition. It was expected for music and food to restore mood after the food consumption task, as an indicator that these stimuli are achieving an emotional regulation function in the groups. In both conditions the presentation of food restored mood, however, eating whilst listening to music did not have an effect on consumption.

4.2. Strengths and weaknesses of the study in relation to other studies

4.2.1. Experimental design

This is the first study to examine the use of music to regulate emotions in children in relation to food consumption following a mood induction. The study was based on a randomised, experimental design created by Blissett et al. (2010) and Farrow et al. (2015), as well as studies with adult populations (Van den Tol, 2022). Previous research has found inconsistent findings on the effectiveness of mood inductions to influence eating; in Blissett et al.'s sample (2010), there was little effect of negative mood induction on eating at 3–5 years, but there was a significant difference of greater than 70 calories consumed between the negative mood induction and control condition when the same sample was 5–7 years old (Farrow et al., 2015). This led those researchers to conclude that the tendency to emotionally overeat is more apparent after the age of 5 years. Our experimental manipulation was not to test the presence of emotional eating by manipulating mood, but rather to examine whether playing happy music would interrupt the link between negative mood and snack food consumption. In adult samples, it was found that listening to music can be effective in reducing snack food consumption if the music counteracted the arousal of the negative mood (Van den Tol et al., 2022).

There was no main effect of happy music versus silence on food consumption in the present study. It could be that children aged 5–7 years are developing the tendency to emotionally overeat but this may not be fully developed, hence we may not have found an effect across the sample. Simply put, if there is less emotional eating present across most of the sample, the use of music would not counter it either for most of the sample. This is in line with several recent studies (Bariola et al., 2011; Blissett et al., 2010; Farrow et al., 2015) which show that emotional eating is a learned behaviour and associated with parental feeding practices. Moreover, there appeared to be an effect of music on eating for those children who have parents who use food as a reward. It is known that parental use of food as a reward predicts later emotional eating, and this may account for our observed interaction across multiple foods in the present study (Jansen et al., 2020). Alternatively, it could be that distraction away from the negative mood induction was provided by music or food in the present study, but only for those children whose parents use food as a reward. This could be explained by individual differences as children with high reward and punishment sensitivity are more likely to eat palatable snack foods and may respond differently in these experimental designs (De Decker et al., 2016). This would suggest that there may be individual differences in responses to rewards in the environment, which needs to be further explored (Powell et al., 2017).

Overall, this finding highlights the importance of examining interactions between parental feeding practices and child characteristics on children's use of food to regulate their emotions.

Research has repeatedly shown that music chosen by caregivers is effectively used to regulate children's emotions (Cho & Ilari, 2021; Ilari et al., 2011; Van den Tol et al., 2021). The song 'Happy' by Pharrell Williams was chosen as it was used by the school and was a song that was reported to be positively viewed by the children. An advantage of this approach is that the use of a single song allowed standardisation of the music chosen, across the sample. Reflecting further on the traits of this song, we assume that 'Happy' is a song that would map most well onto music for divergence, which refers to music that regulates emotions by distracting away from a negative mood (Saarikallio et al., 2015).

In the study that investigated the effect of music on emotional eating in adult samples (Van den Tol, et al., 2022), each participant *self-selected* music that had a certain emotional regulation function they identified worked for them in a particular situation/mood. Taking this approach with children would additionally allow researchers to explore the effect of different music types in relation to particular moods, as the current study in children did similarly not look at different types of music in relation to emotional regulation. One drawback however may be that children may not be aware of the effect that different songs have on them. Caregivers do seem aware of how different types of songs have an effect on their children's moods (Cho & Ilari, 2021; Ilari, 2005; Ilari et al., 2011; Van den Tol et al., 2021) hence future research may ask each individual child's primary caregiver to provide this information so that the experiment can be tailored even better to each specific child's response to music in a particular situation.

4.2.2. Mood induction

The use of an experimental mood induction design to induce a negative mood is a strength of the current study, though the effectiveness of the induction needs consideration. The mood induction task, whilst used by other researchers (Blissett et al., 2010; Farrow et al., 2015), was found not to have a very strong effect on the child's reported mood. In fact, throughout the study, the children rated their mood very positively ranging mainly from 'very happy' to 'happy' and not to the unhappy end of the rating scale. Previous research removed any children who did not show an effect of mood induction, reducing their sample sizes (Blissett et al., 2010; Farrow et al., 2015). For the current study, it was decided to run the analyses on the original sample whilst controlling the child's mood after the negative mood induction, rather than removing those who did not show a clear reduction in mood ($n = 32$ of this sample). This means that the amount of food consumed overall was not a result of a negative mood for all children. Future experiments may want to consider the use of better prizes as this may evoke stronger emotions (when the child is told they are not able to receive the prize). Moreover, if the experiments included control conditions with no mood induction, it would help evaluate whether it is the negative mood that is driving the findings (Blissett et al., 2010), or whether it is the provision of unhealthy snacks in schools. Interestingly the children's mood in this study increased when they were given the snacks regardless of condition. Schools in the UK are encouraged to implement the Government School Food Standards, and it is recommended that unhealthy packaged snack foods are restricted (Department of Education, 2022), which may be crucial in how the children viewed the food presented.

4.3. Mechanisms and implications of the main findings

4.3.1. Parental feeding practices

It is well established that parental use of food as a reward in primary school-aged children is associated with an increased tendency to eat when in a negative mood (Cooke et al., 2011; Farrow et al., 2015; Powell et al., 2017). By using food as a reward, parents are teaching children to associate certain foods with positive outcomes and thus they may regulate their emotions by turning to these rewards when in a negative

mood (Christensen, 2019). It is known that the use of food as a reward increases the value of food to the child, thus making it more rewarding and a stronger driver of behaviour (Bauer et al., 2021). The impact of using food as a reward on consumption may support the Escape Theory, which suggests that emotional eating is both triggered by negative emotions and provides an immediate distraction (Heatherton & Baumeister, 1991).

In the present study, parental use of food as a reward had a moderating effect on consumption; children whose parents used high food as a reward ate more snack foods in the silence condition. Although the mechanism cannot be confirmed, it seems that certain parental strategies may influence how children respond to novel emotion regulation techniques, in this instance the use of music.

Unlike in previous studies (Blissett et al., 2010), there was no effect of parental use of food for emotional regulation on the consumption of foods. There may be several reasons for this. It could be the age difference in our sample (5–7 years) and that of Blissett et al. (2010) who found an effect in 3–5 year old children may explain the difference, and there are developmental changes in the effect of parental feeding practices on child consumption (Farrow et al., 2015). Another explanation could be the fact that some children did not reduce their reported mood so may not have been sufficiently unhappy enough to need food to regulate their emotions. In fact, children seemed to enjoy the whole experimental procedure within the school environment. This study would need to be replicated in a more naturalistic environment to examine the relationship between the use of food to regulate emotions and negative moods in children, and whether more adaptive techniques such as music may have the potential to be used as an alternative by parents. In addition, future research should look at the feasibility of getting parents to change the means they use to regulate their children's emotions and to reward them. As well as music, there are other potential regulators that may be useful as an alternative to food. For example, social praise as a reward, as well as more tangible rewards like screen time or non-food prizes (Adise et al., 2018; Cooke et al., 2011).

4.3.2. Individual differences in children

Despite emotional eating traditionally being studied and referred to in terms of negative affect, a recent meta-analysis indicated that over-eating can be observed as the result of both positive and negative emotional states (Evers et al., 2018), and also depends on individual characteristics; for example, compared with unrestrained eaters, self-reported restrained eaters consume more under negative emotional states (Polivy, Herman, & Deo, 2010). We did not look at the eating behaviours of the children in our study, for example, whether the children were high in food approach behaviours, a cluster of eating behaviours including, food responsiveness, emotional eating, and enjoyment of food, that results in some children seeking out, enjoying and consuming more foods (Wardle et al., 2001). It is known that parents may use different food emotion regulation strategies with children who show more approach behaviours, as they are more motivated by food, and as such food is an effective reward and regulator for these children (Jansen et al., 2020; Roberts et al., 2018). Future research should also look at the characteristics of the child, and whether this influences the effectiveness of music as a mood regulator.

4.4. Conclusion

Eating to regulate emotions has been found in people of all ages and it has been suggested to be more apparent in children whose parents use certain feeding practices such as using food as a reward and using food for emotion regulation (Blissett et al., 2010; Farrow et al., 2015). As these cognitive associations are made from an early age, exploring other coping mechanisms that can be used in children may prove to be beneficial. Music is an alternate mechanism that can be used as a reward and to regulate emotions (Papinczak et al., 2015), and the present study explored its use as an alternative to unhealthy snack food consumption.

The current study aimed to explore the impact of music on food consumption and found that even though no significant differences were found between the music and silent conditions overall, there was an interaction between parental use of food as a reward and the music condition on the amount of food consumed by the children. However, this same effect was not found for using food for emotional regulation and was not related to child BMI. The findings from this study can have implications on the advice and guidelines that are given to parents in relation to the best ways to reward their children and regulate their emotions, and become more aware of the strategies they use. In particular adaptive regulation strategies such as music should be part of their parenting techniques. However, further research is needed which manipulates the research design to determine whether certain types of music have a different impact on food consumption in children, and at what ages music may be an effective regulator.

Author contributions

HC, SJ and AVDT contributed to the design of the study. SJ and SR collected the data and created the dataset. SJ and HC conducted the data analyses and wrote the first draft of the manuscript with support from AVDT, who provided advice and reviewed and edited the manuscript. All authors (HC, SJ, AVDT and SR) approved the final version of the manuscript.

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Ethics declaration

The study received full ethical approval from the Health & Life Sciences Faculty Research Ethics Committee (2045). Informed consent was obtained from parents and assent was taken from child participants.

Declaration of competing interest

There is no conflict of interest for any of the authors.

Data availability

Data will be made available on request.

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