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Citation for published version (APA):

Jansen, A. T. M., & Tenney, N. (2001). Original Communication: Seeing mum drinking a 'light' product: is social learning a stronger determinant of taste preference acquisition than caloric condition? *European Journal of Clinical Nutrition*, 55, 418-422. <https://doi.org/10.1038/sj.ejcn.1601175>

Document status and date:

Published: 01/01/2001

DOI:

[10.1038/sj.ejcn.1601175](https://doi.org/10.1038/sj.ejcn.1601175)

Document Version:

Publisher's PDF, also known as Version of record

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Original Communication

Seeing mum drinking a 'light' product: is social learning a stronger determinant of taste preference acquisition than caloric conditioning?

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Objective: It was examined whether caloric conditioning or social learning strategies dominate in taste preference acquisition in children. The caloric learning paradigm predicts that eating or drinking artificially sweetened products, which deliver virtually no energy, will not lead to a taste preference whereas the social learning paradigm predicts that seeing important others modelling the eating and drinking of these 'light' products will induce a preference for the taste of light products in the child.

Design: In a 2×2 between subjects factorial design, the amount of energy and social modelling was varied.

Setting: The study was undertaken at primary schools in Maastricht, The Netherlands.

Subjects: Forty-five children participated and six children dropped out. The 39 children who completed the study (14 boys and 25 girls) had a mean age of 67 months (range 51–81, s.d. 5.6).

Interventions: Each subject took part in nine conditioning trials with an individually selected tasting yoghurt which was not preferred very much at the pre-test.

Results: The children in the combined caloric and social condition showed an increase in their preference for the conditioned taste which was larger than a regression-to-the-mean effect ($P = 0.007$), whereas children in the other groups did not.

Conclusion: Caloric and social learning combined, ie modelling the consumption of energy-rich foods or drinks, is the best way to establish taste preferences. Children more easily learn a preference for energy-rich food that is eaten by significant others than for food that is low in energy and eaten by significant others.

Descriptors: taste preference; light food; caloric conditioning; modelling; social learning

European Journal of Clinical Nutrition (2001) 55, 418–422

Introduction

Research on taste preference learning shows that caloric conditioning and social learning (modelling) are two robust methods to acquire a preference for a specific taste (eg Capaldi, 1996; Rozin & Zellner, 1985). If a taste reliably predicts the ingestion of food that elicits a pleasurable

satiety effect, the taste will become a conditioned stimulus for a pleasurable state, leading to a preference for that taste by means of caloric conditioning. Thus, caloric conditioning theory states that the pleasurable state of satiety following a meal increases the preference for the taste of the food that brings about the satiety. A series of elegant studies using caloric conditioning paradigms indeed have shown that subjects learn a preference for the taste of foods which are rich in energy (carbohydrates or fat) whereas they do not learn a preference for the taste of foods that are low in energy (eg Birch, 1987, 1989, 1991; Booth, 1985; Capaldi, 1996; Garcia *et al*, 1974; Kern *et al*, 1993; Rogers, 1994; Sclafani, 1991).

A second robust determinant of taste preference acquisition is social learning (Birch, 1989, 1991; Horne *et al*, 1995; Rozin, 1989; Rozin & Zellner, 1985). An intriguing demonstration of the social learning influence is the study of Rozin and Kennel (1983) in which two chimpanzees learned to prefer piquant crackers (containing chilli pepper)

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Contributors: The Dutch Sugar Bureau (A Balffoort) and AJ co-formulated the general research question. AJ formulated the specific hypotheses and created the experimental design of the study together with NT. NT recruited schools and subjects and collected the data under supervision of AJ. AJ analysed the data and wrote the paper.

Received 14 August 2000; revised 19 December 2000;

accepted 21 December 2000

above plain crackers, taking their caretaker as a model. Piquant crackers are innately aversive foods for these animals and the chimps acquired liking for them by means of social learning. Better controlled studies with human subjects show that children especially learn or change taste preferences by seeing their parents or peers liking particular foods and by hearing stories featuring a hero who expresses a strong preference for a particular food (Birch, 1980; Horne *et al*, 1995; Rozin, 1989). Thus, by observing significant others (peers, parents, heroes), children learn to prefer food that is eaten and positively evaluated by these models. A relevant question is which of these taste preference learning strategies dominates. Consider, eg, artificially sweetened foods and drinks, the caloric learning paradigm predicts that eating 'light' products, which deliver virtually no energy, will not lead to a taste preference because the drink is low in energy whereas the social learning paradigm predicts that seeing a parent modelling the consumption of 'light' products will induce a preference for the taste of light products in the child. In the present study we examined which of both learning procedures dominates in the taste preference acquisition in children.

Method

Overview

In a 2×2 between-subjects factorial design, the amount of energy and social learning were varied. Half of the subjects ate yoghurt rich in energy and half of the subjects ate yoghurt low in energy. Furthermore, half of the subjects took part in a social learning ritual and the other half did not, yielding four groups. Each subject took part in nine conditioning trials with an individually selected taste which was not liked very much (ranking 3 on a 1 (least preferred) to 8 (most preferred) scale). Before and after conditioning taste preferences were assessed.

Subjects

Forty-five children participated voluntarily in the experiment. Six children were considered dropouts because they missed more than 25% of the learning trials ($n = 1$), ate less than 60% of the offered amount ($n = 1$) or a combination of both ($n = 4$). Thirty-nine children, 14 boys and 25 girls, with a mean age of 67 months (range 51–81, s.d. 5.6) completed the study.

Materials

High- and low-energy yoghurt drinks were prepared and served in 200 ml cups. The high-energy yoghurt contained 1327 kJ per 200 ml whereas the low-energy yoghurt contained 336 kJ per 200 ml. The high-energy yoghurt was prepared from 157 ml full-cream yoghurt, 31 g sugar and 12 ml salad oil. The low-energy yoghurt consisted of 200 ml skimmed milk yoghurt and 0.64 g aspartame. Both

yoghurt variants were pink-coloured and flavoured with one of eight different flavours: papaya, gooseberry, plum, melon, blackberry, apricot, kiwi and red currant. By pilot testing with adult subjects, the taste of the flavoured high- and low-energy yoghurt variants was made as similar as possible. The yoghurt drinks were prepared about 2 h before eating and they were served in a coloured plastic cup with the name of the child on it.

Preference assessment

Preferences were assessed according to Birch's procedure to measure young children's food preferences (eg Kern, *et al*, 1993; Sullivan & Birch, 1990). Before assessment, the procedure was explained in class. The meaning of three cartoon faces was discussed; one face reflected someone who had just eaten something that was liked very much, one face reflected someone who had just eaten something that was disliked very much and one face had a neutral expression. Next, each child was seen individually by the experimenter in a separate room in the school building. Together they discussed the faces again, until it was clear that the child understood the meaning of the expressions. Following this training procedure, the child was presented with the eight cups of yoghurt and tasted one or two spoons of a cup. The child was asked, 'How is it? Is it yummy, yucky, or just OK?' After the child had placed all the yoghurt in front of one of the faces, he or she was asked to rank the yoghurts within each category. The yoghurts placed in one category were tasted once again and the taste which was liked the very best was chosen. This yoghurt was removed and the procedure was repeated for the remaining yoghurts until a complete rank order of the child's preferences was obtained with taste 8 being the most preferred and taste 1 being the least preferred. Children assigned to the energy-rich condition assessed tastes that were rich in energy, whereas children assigned to the low-energy condition assessed artificially sweetened tastes.

Procedure

Preference assessment took place on Fridays, 3 days before the learning trials started (pre-test) and one day after the nine learning trials finished (post-test). For each individual the taste which was ranked number 3 on the preference assessment pre-test was used as the conditioning taste in nine conditioning trials. Because caloric conditioning is state-dependent (hungry subjects learn a stronger preference for a taste which is associated with satiety than sated subjects do), all conditioning trials took place just before lunch.

Caloric conditioning. The participating children ate the yoghurt promptly after the morning lessons at 11.30 am, while mothers and fathers or caretakers were waiting outside. The children remained in the classroom and received a plastic coloured cup with his or her name on it and filled with 200 ml yoghurt. The child was instructed by the experimenter to eat the yoghurt and to eat it all up. After

finishing the yoghurt the child left the classroom and went home with his or her parent or caretaker.

Social learning. In the social learning group, the yoghurt was also eaten promptly after the morning lessons at 11.30 am. The yoghurt was given the name ‘yogayippie’ and each conditioning trial started with two teachers consuming the ‘yogayippie’ while repeatedly and enthusiastically praising it for its taste, a method which has been found very effective (Hendy & Raudenbush, 2000). Then, in trials 1 and 5, the teacher told a story about a yogayippie-eating hero during which the children were presented with a colouring picture that was going together with the story. Next, the child received a plastic coloured cup with his or her name on it and filled with 200 ml yoghurt (presented as yogayippie). The child was instructed to eat the yoghurt and to eat it all up. During each trial, a parent or caretaker of the child was present and sitting next to the child. The adult also ate a cup of yoghurt (with the same taste as the yoghurt of the belonging child) and the adult repeatedly praised the yoghurt for its taste.

Results

Table 1 shows the mean preference rankings of taste number three for each group on the post-test. A 2 (energy: high vs low) × 2 (social learning: strong vs weak)

Table 1 Samples sizes, means and standard deviations between parentheses of the preference rankings of taste number 3 on the post-test for each group

	Caloric conditioning +	Caloric conditioning –
Social learning +	n = 10 6.1 (1.4)	n = 10 5.6 (2.2)
Social learning –	n = 9 4.8 (2.2)	n = 10 5.1 (1.6)

ANOVA with repeated measurements (time: pre-test vs post-test) showed a highly significant time effect ($F(1,35) = 63.1, P < 0.001$). No other main or interaction effects were found. Figure 1 shows that the subjects in all conditions increased their preference for taste number 3 after conditioning. Considering the unconditioned tastes (all except taste 3), Figure 2 shows that there was a trend to prefer disliked tastes more at the post-test and to prefer liked tastes less at the post-test. To correct for this regression-to-the-mean effect, the post-test preference ranking score for taste number 3 was corrected for the maximum regression effect, ie by subtracting 1.5 (the mean value of the eight ranking numbers (4,5) minus 3) of the post-test ranking scores. Again, a significant time effect ($F(1,35) = 8.81, P = 0.005$) emerged and no main or interaction effects were found. Thus, after correction for the maximum regression effect, the increase in preference for taste number 3 continued to exist in all groups. Subsequent

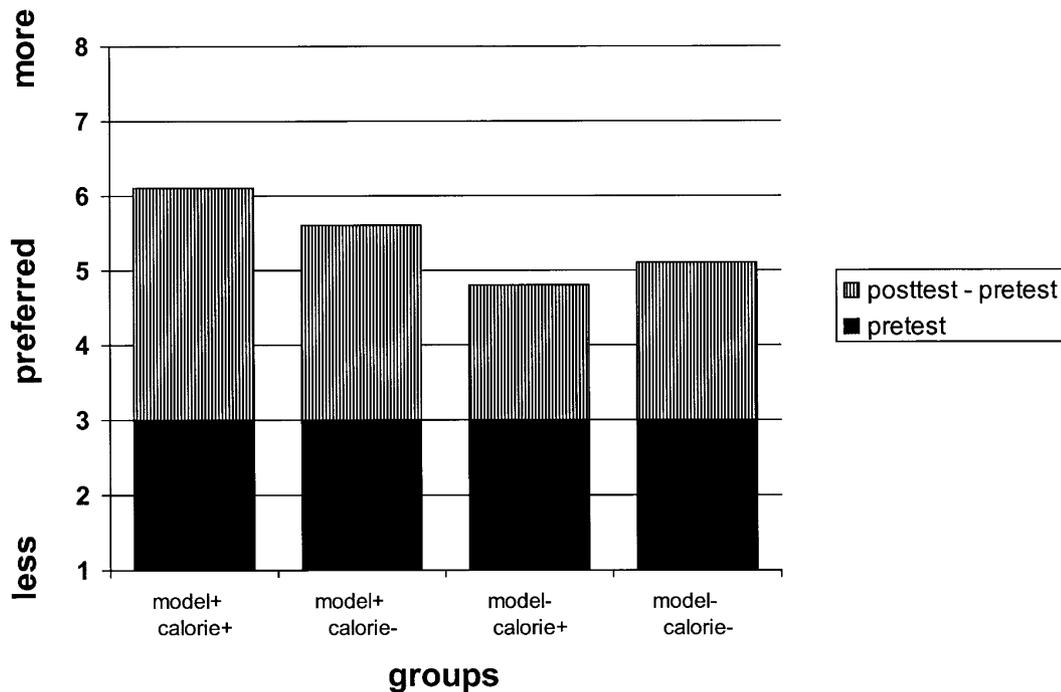


Figure 1 The mean preference ranking of taste number three at the pre-test and at the post-test for each group (calorie + model + = high-energy yoghurt group with social learning; calorie + model – = high energy yoghurt group without social learning); calorie – model + = low-energy yoghurt group with social learning, calorie – model – = low-energy yoghurt group without social learning).

t-tests for paired samples on the corrected post-test scores showed that the significant time effect could be ascribed to the change in the high energy + social learning condition; this group showed a significant increase in preference for the corrected taste number 3 after conditioning ($t(9)=3.49, P<0.01$) whereas the other groups did not (high-energy without social learning, $t(8)=0.37, NS$; low-energy with social learning, $t(9)=1.6, NS$; low-energy without social learning, $t(9)=1.2, NS$). It is thus concluded that the high-energy + social learning group showed a conditioned taste preference, whereas the effects in the other groups appeared to be regressions to the mean.

Discussion

In the present study, it was examined which taste preference learning strategy dominates in taste preference acquisition in children: caloric conditioning or social learning. The question is particularly interesting when considering the consumption of artificially sweetened foods and drinks: the caloric learning paradigm predicts that eating 'light' products, which deliver virtually no energy, will not lead to a taste preference because the drink is low in energy, whereas the social learning paradigm predicts that seeing a parent modelling and reinforcing the eating and drinking of 'light' products will induce a preference for the taste of light products in the child. Four groups of children, in whom the amount of energy and social modelling was varied, participated in the experiment. It was found that all children showed an increase in preference for the taste they

repeatedly tasted. It is well known that mere exposure increases liking for a flavour (eg Birch, 1987; Kern *et al*, 1993), but in the present study it is not clear whether the increased liking is due to mere exposure or a statistical artefact, ie a regression-to-the-mean effect. It is clear, however, that the children in the condition with the strongest manipulation (consuming high-energy yoghurt with caretaker in a yogayippie context; a combination of caloric and social learning) showed a larger increase in preference for the conditioned taste, ie taste number 3, than the other groups. It thus can be concluded that when children are socially reinforced for the consumption of foods or drinks rich in energy, they will easily learn a taste preference for that food, whereas children who are socially reinforced for the consumption of 'light' products will not easily learn a preference for the taste of these light products.

The present data, in particular the regression to the mean effect, casts some doubt on the test–retest reliability of the present preference assessment procedure. A reliable assessment procedure would have shown no major changes in ranking scores during the second test, except for the conditioned taste. Spearman correlation coefficients between the pre- and post-preference assessment test (the frequently eaten taste number 3 was excluded from analysis) were, however, low and non-significant (ranging from 0.04 to 0.28). This sharply contrasts with early findings of Birch who found a mean rank order correlation of 0.45 (Birch, 1979a) and 0.58 (Birch, 1979b). There was one striking difference between Birch's preference assessment and the present one. Birch used eight more or less familiar foods (spreads on a sandwich (Birch, 1979a) and fruits

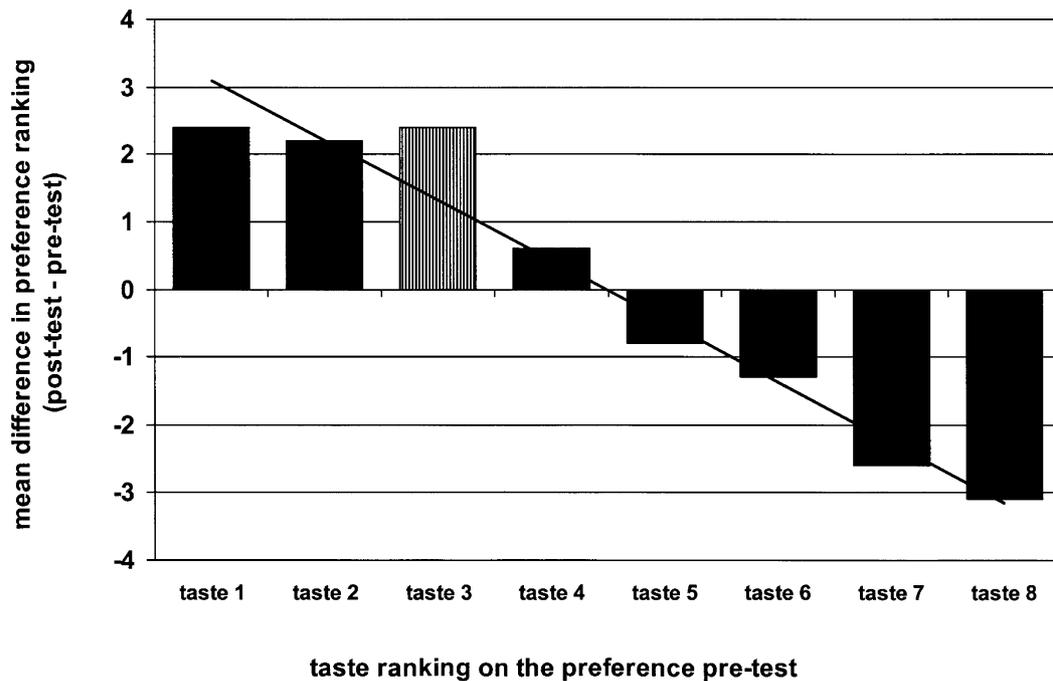


Figure 2 Mean differences in preference ranking from pre-test to post-test for the tastes that were ranked 1–8 on the pre-test.

(Birch, 1979b)), whereas in the present study eight new and unknown artificial flavours added to yoghurts were used. In later studies, Birch also used artificial flavours; however, only two (Birch, *et al.*, 1990; Johnson, *et al.*, 1991) and five (Kern, *et al.*, 1993) different flavours were used. Thus, when the assessed foods are more familiar and visually distinguishable, more food items can be used for a reliable ranking score, whereas a large amount of unfamiliar tastes which are also visually undistinguishable, reduces reliability.

All in all, the present study shows that a combination of caloric and social learning, ie modelling the consumption of energy-rich foods or drinks, is the best way to establish taste preferences. Children will more easily learn a preference for energy-rich food that is eaten by significant others than for food that is low in energy and eaten by significant others.

Acknowledgements—The present study was supported by a grant of the Dutch Sugar Bureau. Quest International (Naarden) is gratefully acknowledged for supplying us with the flavours and aspartame. The Holland Sweetener Company is thanked for the quick delivery of more aspartame. The teachers and children of the schools are thanked gratefully for their participation. Fren Smulders and Eric Schouten are thanked for their statistical advice, Chantal Nederkoorn and Brigitte Boon for their comments on the paper, and Marja Hortulanus for her logistic assistance.

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