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# Evaluative conditioning of attitudes towards nutrition: a systematic review of research using food and body stimuli

**Abstract:** This systematic review examined studies investigating evaluative conditioning (EC) effects using food stimuli as conditioned stimuli (CS) and body silhouettes as unconditioned stimuli (US). Following PRISMA guidelines, 162 records were identified, of which three studies met the inclusion criteria and were included in the final analysis of methodological characteristics and outcomes. The review focused on technical elements (stimulus types, presentation parameters, trial numbers) and functional properties (conditioning effects, extinction patterns) of EC procedures. Analysis revealed consistent evidence for successful conditioning effects, particularly when pairing food images with obese body shapes, resulting in decreased CS ratings post-conditioning (effect sizes ranging from r = .26 to .41). However, studies exhibited considerable methodological heterogeneity in stimulus presentation times (400-7000ms), trial numbers (18-144), and measurement approaches. Key procedural variations included gender representation in US stimuli, CS categorization (single items vs. food categories), and assessment methods (explicit ratings vs. implicit measures). The findings highlight the need for greater methodological standardization in EC research using food-body associations, while suggesting EC's potential utility in modifying food-related attitudes. Future research directions should address gender balance in sampling, standardization of stimulus sources, and investigation of potential mediating mechanisms. The results point to potential relevance for nutrition education and public health contexts, while also underscoring the importance of further research on the effectiveness, stability, and ethical implications of such applications.

**Keywords:** *evaluative conditioning, nutrition stimuli, body stimuli, attitudes, picture stimuli*

## INTRODUCTION

The main objective of the current systematic literature review is to verify previous research results devoted to the importance of using silhouette stimuli and food-presenting stimuli together in a conditioning procedure for the acquisition of attitudes about nutrition. Therefore, in this review, we want to answer whether there are significant differences in the procedures, considering the most critical elements of research using the evaluative conditioning procedure. Moreover, another goal is to propose paths for further exploration, analyzing the components used in creating procedures based on the conditioning paradigm. In addition to the analysis of indicators proposed above, demographic data and specific study design features are included for comparison.

Our attitudes form and change constantly throughout life. One of the most straightforward explanations of how attitudes change refers to the evaluative conditioning (EC) effect. The evaluative conditioning effect is a change in the rating of the initially neutral stimulus (conditioned stimulus - CS) due to its repeated pairing with affectively laden stimuli (unconditioned stimulus – US) (Balas & Sweklej, 2017). We may start to like or dislike items,



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people, or ideas because they repeatedly occur with other events that we already evaluate positively or negatively (ex., kill-the-messenger effect when an agent revealing negative information starts being disliked) (Weber et al., 2020). Typically, a neutral CS acquires the affective value of a paired US (Hofmann et al., 2010) unless a qualitative relation between the two is not defined during learning (De Houwer et al., 2001). For example, seeing a new person together with your friend typically results in a more favorable evaluation of this person. However, seeing a new person together with your friend and finding out that this person holds your friend hostage is an entirely new story. What significantly broadens the applicability range of EC is that not only may EC impact the formation of attitudinal responses towards initially neutral stimulus (there are not many of such around us), but it also may change already present evaluations (Hofmann et al., 2010). For example, repeatedly seeing your respected work colleague with someone you dislike may result in a downgrading of how you evaluate this person.

There are two primary theories explaining the EC effect. The associative account posits that the correlation between conditioned and unconditioned stimuli happens automatically, requiring minimal cognitive engagement and often occurring subconsciously (Gawronski & Bodenhausen, 2018). Conversely, the propositional model suggests that EC results from conscious cognitive judgment about the relationship between two co-existing stimuli (Hu, Gawronski, Balas, 2017). In contrast to these single-process models, the associative-propositional evaluation (APE) model integrates both theories. The APE model proposes that associative and propositional processes jointly contribute to EC. Associative processes involve automatic links formed between stimuli, while propositional processes entail deliberate, reasoned evaluations. This dual-process approach offers a comprehensive understanding of how attitudes form and change, acknowledging the roles of automatic associations and conscious judgments.

## Technical and Outcome Elements of Conditioning Procedures

The elements deemed essential in studies utilizing the evaluative conditioning (EC) paradigm can be classified into two categories: *technical elements*, which concern the construction of the experiment and research methodology (e.g., types of stimuli, number of stimuli, number of stimulus pairings, types of pairings, pairing method, and stimulus presentation time), and *functional properties*, which relate to the effects of conditioning (De Houwer et al., 2001).

### *Technical Elements of EC*

The first important element is the type of stimuli, which can be divided into conditioned and unconditioned stimuli. The unconditioned stimulus (US) is a stimulus that naturally elicits a response without prior learning (Davey, 1992). This is usually a biologically significant or emotionally arousing stimulus (Olsson & Phelps, 2004). The conditioned stimulus (CS), typically neutral, is associated with the unconditioned stimulus through repeated pairings (Lovibond & Shanks, 2002). Initially, the CS does not provoke a response, but after conditioning, it elicits a reaction similar to the US (Waroquier et al., 2020). Conditioning represents the temporal relationship between the presentation of the CS and the US (Gawroński et al., 2018). This relationship refers to the predictability or reliability of CS-US pairings, indicating how consistently the CS predicts the occurrence of the US (Gast et al., 2012). Another crucial aspect is the type of stimuli presented. For instance, the conditioned stimulus might be an image, sound, or scent paired with an emotionally significant positive or negative stimulus.

The next element concerns the frequency and number of stimulus pairings. The number of CS-US pairings influences the strength of the conditioning effect. Generally, repeated pairings increase the strength of evaluative conditioning, although in some cases, a single pairing may suffice ((Gawroński et al., 2018)). Another important aspect is the type of pairings constructed. These can be classified as *single pairings*, where the CS and US are always the same, or *multiple pairings*, where the CS is paired with several USs of the same valence (Moran et al., 2023).

In addition to the type of stimulus pairings, the method of pairing the CS and US is critical. Research methodologies can involve simultaneous pairing, where the CS and US are presented at the same time, or sequential pairing, where the CS appears either before or after the US (Stahl & Heycke, 2016). Another critical element is the duration of stimulus presentation, which can affect the efficiency of the conditioning process. Generally, shorter intervals between stimulus presentations are more effective than longer ones (Hütter et al., 2014).

### *Functional properties EC*

The outcome characteristics of evaluative conditioning (EC) research encompass several key aspects. The first is the durability of the evaluative conditioning effect, which is generally high, even with limited pairings. Associations formed during conditioning tend to be resistant to extinction, meaning that the effect may persist even after the conditioned stimulus (CS) is no longer paired with the unconditioned stimulus (US) (Gawroński et al., 2015; De Houwer et al., 2001). Another crucial feature is resistance to awareness-research indicates that conditioning can occur even when participants are unaware of the associations between the CS and US, suggesting that these processes operate subconsciously (Olson & Fazio, 2004; De Houwer et al., 2001; Stahl, Unkelbach & Corneille, 2009).

A further characteristic is the transfer of effect-associations formed through conditioning can generalize to other, similar stimuli. For instance, positive emotions elicited by one image may transfer to other images that share similar features (Hermans et al., 2005). The intensity of the US influences the strength of the emotional response-the stronger the emotions elicited by the US,

the more effective the conditioning (Olsson & Phelps, 2004). Additionally, the specificity of the stimulus plays an important role. Some stimuli, such as visual cues, may be more susceptible to conditioning than others, such as auditory stimuli, depending on the research context (Gast et al., 2012).

The last two typical EC elements are extinction and spontaneous recovery. Extinction refers to the gradual weakening and eventual disappearance of the conditioned response when the conditioned stimulus is presented repeatedly without the unconditioned stimulus (Gawroński et al., 2015). On the other hand, spontaneous recovery refers to the reappearance of the conditioned response after rest following extinction (Bouton, 2002). Understanding these key elements allows researchers to investigate the mechanisms and effects of evaluative conditioning, contributing to our understanding of how attitudes, preferences, and emotional responses can be shaped through associative learning processes (Hofmann et al., 2010). Due to methodological differences between studies on attitude acquisition, EC's described characteristics are crucial in analyzing the current literature on nutritional attitudes.

***Cognitive measures of evaluative conditioning (EC)***

Evaluative conditioning can also be modified by other cognitive processes, such as prior experiences or implicit attitudes, indicating that it interacts with other cognitive mechanisms (Gawroński & Bodenhausen, 2001). Individual differences also play a significant role-the effect of conditioning may vary based on personal characteristics such as emotional sensitivity, personality traits, or past experiences (Field et al., 2016).

One key cognitive measure is explicit self-report scales, where participants are asked to rate their attitudes toward conditioned stimuli (CS) using scales like "liking" or "pleasantness" (Hofmann et al., 2010). These measures capture the conscious evaluations formed after conditioning. Another important method is implicit measures, such as the Implicit Association Test (IAT) or evaluative priming tasks. These tests assess automatic, unconscious associations between the conditioned stimulus and positive or negative attributes (De Houwer et al., 2001; Olson & Fazio, 2001). Additionally, reaction time tasks measure how quickly participants associate the CS with specific attributes, providing insights into implicit cognitive processes (Gawroński & Bodenhausen, 2001). By comparing the results of explicit and implicit measures, researchers can better understand how EC influences conscious and unconscious attitudes.

**EC in nutrition attitudes**

Most research on nutrition preferences using the evaluative conditioning paradigm shows studies differing in terms of their research objectives, hypotheses, and elements of the procedure considered and described above. On the one hand, we can point to studies that will analyze the impact of EC on health behavior (Hollands et al., 2011) and assess whether a food is generally healthy or unhealthy (Hensels & Bainse, 2016). On the other hand, one can also identify several studies that will focus on the acquisition of preferences for specific flavors (Brunstrom et al., 2005), specific food products (Wang et al., 2017), or even specific food brands (Kerkhof et al., 2009). Moreover, studies examine sustainability preferences and processed versus unprocessed foods (Chen et al., 2022). Research using the EC mechanism and in the context of nutrition and healthy attitudes involved pairing stimuli of healthy and unhealthy foodstuffs and stimuli presenting the health consequences of eating certain foods (Hollands & Marteau, 2016). On the other hand, studies were conducted using stimuli presenting food and various body types (Dwyer et al., 2007; Lebens et al., 2011). The studies above have mainly focused on analyzing overt and covert attitudes about various aspects related to nutrition and have centered around food choice (what to eat) or food consumption (how much to eat), leading to mixed results in terms of attitudes (Hollands et al., 2011; Lebens et al., 2011; Walsh & Kiviniemi, 2014; Hollands & Marteau, 2016; Wang et al., 2017).

In summary, studies on nutrition preferences through evaluative conditioning encompass various topics, from health behaviors and overall food healthiness to specific flavor and brand preferences. This variation in focus and methodology has produced inconsistent results, especially in terms of influencing food choices and consumption attitudes. Although EC holds the potential for shaping nutrition-related attitudes, the differing outcomes emphasize the need for more focused and consistent approaches to evaluate better its role in encouraging healthier eating habits (Shaw et al., 2016).

**CS and US stimuli**

The stimuli used in nutrition research employing EC-like procedures varied depending on the stated research objectives. Although the stimuli used during ECs, both CS and US, are often imaging stimuli (Dwyer et al., 2007), it is increasingly common to find other types of stimuli being used. For example, a line of taste-smell studies (Van den Bosch et al., 2015; Ruszpel & Gast, 2018) uses imaging, smell, and taste stimuli. In the study by Herman et al. (2005), the CS stimuli were pictures of yogurts of different brands, and the US stimuli were positive or negative odors. In another study by Van den Bosch et al. (2015), four novel neutral odors (CS) were associated with different stimuli: taste and pictures (US).

In conclusion, the variety of stimuli used in EC research reflects the field's growth, with researchers now using multiple senses to understand food-related attitudes and preferences better. While this shift from solely using images enhances EC's potential to shape and measure nutrition behaviors more effectively, it also introduces challenges, such as increased complexity in experimental design and the potential for more variable results, which may complicate the interpretation and application of findings.

The range of stimuli used in nutrition research employing evaluative conditioning (EC) procedures varies depending on the stated research objectives. Although both

conditioned stimuli (CS) and unconditioned stimuli (US) are often imaging stimuli (Dwyer et al., 2007), other types of CS stimuli are increasingly common.

***CS Stimuli***

For example, a line of taste-smell studies (Van den Bosch et al., 2015; Ruszpel & Gast, 2018) utilizes imaging, smell, and taste stimuli. In the study by Herman et al. (2005), the CS stimuli were pictures of yogurts of different brands. Similarly, in another study by Van den Bosh et al. (2015), four novel neutral odors were used as CS stimuli and were associated with different US stimuli. In research focusing on taste-taste conditioning, Davies et al. (2012) used three novel taste stimuli as CS. Additionally, in Brunstrom et al. (2005) study, three novel flavors were used as CS stimuli, combined with US stimuli. In research on satisfaction with one's appearance, silhouettes, and face stimuli have been used as CS stimuli. For example, in studies by Martijn et al. (2010, 2013), female participants' silhouettes or images of the faces of women from a control group were used as CS stimuli. Their subsequent replication (Glashouver et al., 2019) continued to use silhouettes and faces as CS stimuli.

***US stimuli***

Unconditioned stimuli (US) in nutrition research also vary and often expand beyond taste and smell. In Herman et al.'s (2005) study, the US stimuli were positive or negative odors. Van den Bosch et al. (2015) used taste and picture stimuli as US, pairing them with novel odors (CS). In the taste-taste conditioning research conducted by Davies et al. (2012), sugar, saline, and water were the US stimuli used with novel taste CS stimuli. Brunstrom et al. (2005) combined chocolate as the US stimulus with novel flavors (CS).

Additionally, research on appearance and body satisfaction uses facial and silhouette stimuli as US stimuli. For example, Hensel's and Baines (2016) used happy and angry faces as US stimuli, associating them with healthy and unhealthy foods as CS stimuli. Similarly, in Martijn et al.'s (2010, 2013) and Glashouver et al.'s (2019) studies, the US stimuli included photos of faces from the NimStim Facial Stimuli Set, which were paired with CS stimuli of silhouettes and faces.

To sum up, research on cognitive resources in taste-taste conditioning reveals a complex interaction between various stimuli, including taste and smell, and visual elements like body silhouettes and facial expressions. The studies discussed show the diverse ways that conditioned stimuli (CS) and unconditioned stimuli (US) can be combined, extending beyond simple sensory associations to include factors like body image and emotional responses (Olatunji & Tomarken, 2023). This research provides important insights into how these stimuli affect perceptions and behaviors.

On the positive side, this research enhances our understanding of what influences taste preferences and body image, which could lead to improved strategies for addressing issues such as eating disorders and obesity and promoting healthier eating habits. On the downside, the variability and complexity of the stimuli used in these studies might result in inconsistent results, complicating the ability to make clear conclusions. Additionally, using stimuli related to body image could unintentionally reinforce negative societal standards or contribute to body dissatisfaction, highlighting the need for careful consideration in future research to avoid these potential issues.

## METHOD

The review protocol used the updated version of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols (PRISMA) (Page et al., 2021).

**Sources of information**

The systematic review used the electronic database EBSCOhost (APA PsycInfo, APA PsycArticles, Academic Search Ultimate). All articles included in the review were evaluated in advance against eligibility criteria. The review included empirical studies published between 2000 and 2023. The final database search was conducted on September 17, 2023.The article had to be written in English and use a general picture–picture evaluative conditioning paradigm where stimuli pairings are repeatedly presented, and evaluative ratings were used as a measurement method. In addition, the research plan had to include the variable body shape (weight) treated as an independent variable defined as a factor or continuous predictor. The dependent variable, captured as a measure of preference toward nutrition (conditioned stimuli), was measured using one of the following methods: subjective assessment or behavioral preference task.

Primary exclusion criteria included studies conducted on samples of animals or children within the classical conditioning paradigm, studies prepared before the year 2000, and sources that are book chapters or dissertations rather than journal papers.

**Search strategy**

The search queries consisted of all possible combinations of the phrases (1) "evaluative conditioning" (2) "food" (3) "nutrition" (4) "nutrition attitudes" (5) "body image" (6) "body picture" An example query was evaluative conditioning: AND (nutrition* OR food* OR nutrition attitudes* OR body images OR body pictures). We filtered searches to English-written articles published from the year 2000 onwards.

**Selection process**

After the initial verification of the retrieved records, duplicates were removed, and all authors began to verify the titles and abstracts for further qualification of the record in question. In case of uncertainty about the eligibility of a particular record, all authors made the decision jointly. In the next step, accepted records were subjected to full-text scanning by the authors to confirm inclusion and exclusion criteria. Finally, data from the final list of articles were extracted and summarized. A flow diagram is shown in Figure 1.

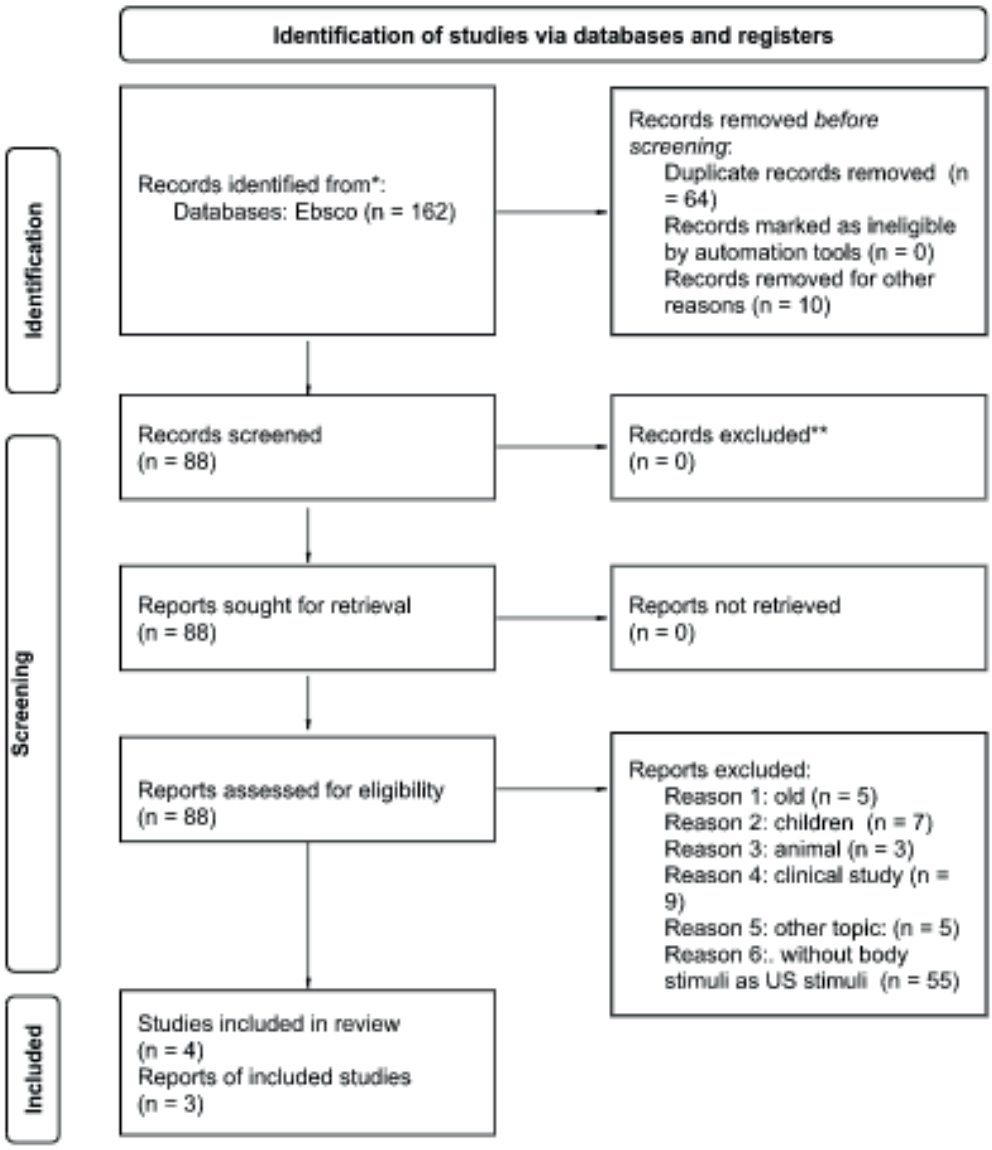


**Figure 1.** PRISMA 2020 flow diagram for systematic reviews included searches of databases and registers only

**Data collection**

The following information on each article included in the review was coded: study design, demographic characteristics of the sample (gender, age), type of CS and US stimuli, number of trials during the conditioning procedure, evaluation method of EC, and cognitive measures of EC.

## RESULTS

A total of 162 records were retrieved from a single source. Removal of duplicates and records that were not articles but, for example, chapters or dissertations allowed 88 records to be retained, which were subjected to a closer scan (title and abstract). Checked titles and abstracts allowed four records to be retained. The records that were removed had to meet specific exclusion criteria. These were articles that (1) were written before 2000; (2) tested animals; (3) included children; (4) dealt with clinical psychology, such as CBT therapy; (5) topics unrelated to nutrition (e.g., smoking, drinking); and (6) body shapes as US stimuli were not included. PU, SS-B, FS, and RB were allowed to in the summary by mutual agreement. The deleted record also used food images such as CS and body silhouettes as US (Holland et al., 2011). It is worth noting, however, that the US stimuli represented the negative consequences of unhealthy eating (the aversive images selected consisted of two images of obesity (in men and women), two images of arterial disease, and one of heart surgery).

The first article included in the review was developed by Lascelles et al. (2003). The research project included the conduct of two experimental studies. They aimed to investigate the potential role of associative learning in the development of eating disorders by using food as conditioned stimuli (CS) and body shapes as unconditioned stimuli (US). Before their implementation, a short pilot study was conducted. Its purpose was to eliminate

**Table 1.** Summary of studies indicating key characteristics

| Study (author, year) | Study design | Demographics | Conditioned Stimuli | Unconditioned Stimuli | CS-US learning phase | CS evaluation method | R Pearson/ Cohen's d effect size | Main Results |
|---|---|---|---|---|---|---|---|---|
| Lebens et al., (2011) | Experimental: Picture-picture evaluative conditioning | Sample:<br>85 female participants;<br><br>Experimental group<br>N = 41<br><br>Control group<br>N = 44<br><br>Age<br>Experimental group: M = 34.14, SD = 12.87;<br>Control group: M = 34.23, SD = 13.49)<br><br>BMI (experimental: M = 24.14, SD = 6.64; control: M = 24.48, SD = 3.92) did not differ between the experimental and control group (age: t (83) = 0.18 p = .86; BMI: t (82) = 1.21, p = .23). | CSs (six snacks: chips, chocolate, cookies, French fries, hamburger, and pizza; and six fruits: apple, grapes, kiwi, melon, raspberries, and strawberries) | USs (six positively and six negatively valenced bodies: lean and overweight) | Trials: 144<br>Trial time: 400 ms<br>ITI: 1500 ms<br>(72 trials displayed snack CSs and 72 trials displayed fruit) | Implicit Association Test (sc-IAT) for positive and negative associations with snack foods. | positive sc-IAT variant:<br>t (83) = 2.08, p = .04, d= 0.46.<br><br>negative sc-IAT variant:<br>t (83) = 2.04, p =.04, d=0.59. | Participants in the experimental group had less positive and more negative associations with snack foods, but there were no significant differences in food purchase behavior.<br><br>While EC altered implicit associations with snacks, it did not affect behavior in the virtual supermarket task, suggesting limited impact on actual food purchasing behavior. |
| Dwyer, Jarratt & Dick (2007) | Experimental: Picture-picture evaluative conditioning | Experiment I: N=64 (32 men and 32 women).<br><br>Experiment II:<br>N = 24 (3 men and 21 women) | Experiment I: CS<br>Eight images of foods (an apple, beans, bread, carrots, an orange, a green pepper, potatoes, and tomatoes). | Experiment I: US<br>Eight images of people selected based on body shape were used as the USs for this study. Four images were obese (two | Experiment I:<br>Foods paired with either obese or normal body shapes (US), some CS images shown alone after training for extinction | Experiment I: Rating scale scale /-100 (extreme dislike) to /+100 (extreme liking) | Experiment I:<br>There was a significant difference in the ratings of the CSs paired with images of obese and normal body shapes in the non-extin- | Experiment I:<br>Foods paired with obese body shapes were rated more negatively. There are no significant differences in extinction. Both men |

| Study (author, year) | Study design | Demographics | Conditioned Stimuli | Unconditioned Stimuli | CS-US learning phase | CS evaluation method | R Pearson/ Cohen's d effect size | Main Results |
|---|---|---|---|---|---|---|---|---|
| | | | Experiment II: CS Eight images of foods were chosen so that four were categorized as fatty (burger, doughnuts, fried breakfast, battered fish and chips) and four as healthy (fruit salad, steamed beans, grilled chicken, green salad) | men and two women), Experiment II: US Six images of women were selected based on body shape were used as the USs for this study. Three images were obese and expected to be rated negatively; three were of average shape and presumably neutral. | Trials: 24 Trial time: 7000 ms ITI: 8000 ms Experiment II: Foods paired either alone or in pairs with obese or normal body shapes (US); testing overshadowing (cue competition) Trials: 18 Trial time: 7000 ms ITI 8000 ms. | | guished condition, F (1, 62)/13.5, MSE/252.1, p/.001, effect size (r/.31, respectively) Experiment II: effect of US weight, F (1, 23) = 10.3, MSE = 561.7, p= .004 no effect size information a significant effect of CS type, F (1, 23) = 18.4, MSE = 959.6, p < .001 No significant effect of overshadowing; effect size not reported | and women were equally affected by evaluative conditioning. Experiment II: Foods paired with obese body shapes were rated more negatively, regardless of whether trained alone or with other foods. No effect of overshadowing was observed in evaluative conditioning. |
| Lascelles, Field, Davey (2003) | Between-groups experiment (experimental vs control group) | Sample: Experiment I: 104 participants (women) ages of the participants ranged from 17 to 50, with a mean of 23.82 (SD = 6.12). Nonclinical population with unlikely ED history Experimental group N= 66 Control group N=38 | Experiment I: 9 food CSs (stir-fry, salad, chocolate cake, ice cream, bread and jam, Chinese prawn noodles, pork chop, English breakfast, pizza) Experiment II: 9 food CSs used in Experiment 1. (Picture A) | Experiment I: 6 images of naked or seminaked women (US- 3 obese US, three normal US, and three thin US) Experiment II The stimuli were the three obese US, three normal US, three thin US (Picture B) | Experiment I: Participants assigned to conditions with 6 CS-US pairs, counterbalanced to ensure no associative bias. Control: CS-CS pairings, US-US pairings to prevent conditioning. Trials: 36 Experimental group Trial time: CS: 7000 US: 7000 ITI: 8000 ms ISI: 200 ms | Experiment I: Rating scale: Evaluative ratings for pre- and post-conditioning (e.g., visual analog scale for food and body images). Experiment II: Participants rated the likelihood of each US being paired with each CS on a 100mm visual analogue scale, ranging from 0 (not | Experiment I: Evaluative ratings from preconditioning to postconditioning in CSs paired with obese USs compared to normal USs showed a significant change, F (1,32) = 6.57, p < .05, r = 0.41 No change was found when comparing obese USs with thin USs, F (1, 32) = 2.36, ns, | Experiment I: Significant conditioning effect in the experimental group for CSs paired with obese USs. Ratings of CSs paired with obese USs became more negative postconditioning. No significant conditioning effect for CSs paired with normal or thin USs, despite thin USs being rated more negatively. |

| Study (author, year) | Study design | Demographics | Conditioned Stimuli | Unconditioned Stimuli | CS-US learning phase | CS evaluation method | R Pearson/ Cohen's d effect size | Main Results |
|---|---|---|---|---|---|---|---|---|
| | | Experiment II: 42 female participants, aged 19 to 44 (M = 24.35, SD = 4.62); 37 completed questionnaires, nonclinical sample. | | | Control group: CS 10 500 ms US: 10 500 ms ITI: 12 000 ms ISI: 300 ms<br><br>Experiment II: Participants received one of three questionnaires containing 54 CS-US pairings, with 9 food CSs and 6 USs (2 from each body shape category) paired randomly. USs were counterbalanced across questionnaires. | likely) to 100 (extremely likely). | r = 0.26, and thin USs with normal USs: F (1, 32) < 1, r = 0.12. Experiment II: r = 0.81 for thin vs. obese/normal USs (large effect size); r = 0.10 (small) for obese vs. normal USs | Experiment II: Obese (M = 52.32, SE = 2.39) and normal (M = 50.55, SE = 1.99) USs were rated significantly more likely to be paired with food CSs compared to thin USs (M = 29.54, SE = 2.42). No significant difference between obese and normal USs (F (1, 34) < 1). The effect of different questionnaires and US type × questionnaire interaction was not significant. |

potential methodological or technical limitations. The pilot study consisted of conducting a trial version of the EC study using the same set of stimuli: CS pictures of food and US pictures of body shapes: obese, average, and slim, which was ultimately used in the main study. The pilot results led to some methodological changes in the experimental procedures. For example, the backgrounds of the US pictures (female shapes) were changed.

This procedure aimed to eliminate the potential influence of backgrounds on participants' evaluations. In addition, while in the pilot study, the US stimuli were chosen by the experimenter, in Experiment I, the US stimuli were chosen by asking participants who did not participate in any of the later stages of the study.

Noteworthy, the presentation times and number of CS and US stimuli were left the same in the experimental study as in the pilot study. The first experiment involved 104 women aged 17 to 50, with a mean of 23.82 (SD = 6.12) (66 participants were assigned to the experimental condition and 38 to the control condition). The CS stimuli used in the experiment presented food (fried meat, salad, chocolate cake, ice cream, bread with jam, Chinese noodles with shrimp, pork chop, English breakfast, and pizza). US stimuli presented three categories of female figures (obese, average, and slim). The unique features of the US stimuli were selected to eliminate their influence on the evaluation ratings maximally. For example, women's faces were covered with a white rectangle to prevent the influence of facial expressions on evaluation ratings. In the experiment, nine CS and nine US stimuli were used. The experimental procedure consisted of 4 stages (preconditioning, conditioning, postconditioning, obesity measurements).

Participants were randomly assigned to the experimental or control condition. Each participant was assigned to a condition containing six pairs of CS-US presentations. The pairs were fully counterbalanced so that all CS were paired with all US participants. In the first stage (preconditioning), participants rated all CS and US stimuli. Then, in the conditioning phase, participants were told that they would be presented with specific pictures and that they were not expected to do anything at this stage of the experiment except to look carefully at the pictures and think about how they made them feel. In the experimental group, each CS-US pair was presented in a pseudo-randomized order, stipulating that the same pair could not be shown more than twice in a row. Each pair was presented three times. Each CS was presented for 7000 ms followed by an ISI of 200 ms, and the corresponding US was then presented for 7000 ms followed by an ITI of 8000 ms. For the control group, the conditioning phase also consisted of stimulus presentation. The difference was that in the BSB (control group), not CS-US, but CS-CS or US-US pairs were presented.

A CS was presented first, followed by another CS stimulus instead of the US stimulus. These stand-alone CS-CS pairs were presented repeatedly until the total number of presentations of a given CS was the same as the total number of presentations in the experimental group. Thus, if there were 10 CS-US pairs in the experimental condition, then in the BSB (control group), there would have to be 5 CS-CS pairs (and 5 US-US) for the CS to be shown ten times. In this experiment, the number of stimulus presentations in the experimental condition was odd (3), which resulted in the total number of presentations for each stimulus in the control group (BSB) not matching the number in the experimental group. Therefore, the parameters in the control group (BSB) were adjusted to the total duration of each stimulus. Each of the CS-CS and US-US pairs was presented twice. The presentation time of each stimulus was 10,500 ms. The ISI was 300 ms, and the ITI was 12000 ms. The third stage of the experiment (postconditioning) followed, during which CS and US were presented in a random order. Participants evaluated each image in the same way as in the preconditioning phase. In the final stage, the perception of obesity was measured. Participants were given a color A4 printout of each US image and asked to record their ratings on a 200-point scale for each picture. The scale ranged from -100 (very thin), through 0 (neutral), to +100 (very obese). This was done to ensure that participants perceived the US stimuli as obese, regular, or thin. Participants were required to indicate their rating for each image by marking a cross on the scale and writing the corresponding value (e.g., -55) beneath the scale.

Experiment 2 investigated how expectancy biases related to the US might contribute to the selective conditioning effects observed in Experiment 1. To examine this, a simulated "thought" conditioning procedure was employed (Davey & Dixon, 1996; McNally & Heatherton, 1993) to reveal any preconditioning biases associated with US expectations. The study involved forty-two female participants, aged 19 to 44 years (M = 24.35, SD = 4.62), 37 completed and returned the procedure. The stimuli utilized in Experiment II were identical to those employed in Experiment I, featuring three representations of obese, three average, and three lean body shapes as USs, alongside nine food CSs.

Regarding methodology, each participant was given one of three questionnaires to complete at their own pace, with no time constraints imposed. Each questionnaire included two of the three USs representing obese, average, and lean body shapes. These USs were paired with nine food CSs, culminating in 54 CS-US pairs. The distribution of USs was balanced across the questionnaires to ensure the creation of three unique versions.

Upon receiving the questionnaires, participants were instructed to imagine participating in a psychological experiment where they would evaluate pairs of images displayed on a computer screen, assessing their likes and dislikes. The instructions indicated that the pairs of images would not be shown simultaneously but would appear consecutively after a brief interval (less than one second). Following these instructions, participants were tasked with determining whether they liked or disliked the second image based on their impressions of the first image and their expectations about the second.

The CS-US pairs were presented randomly across the questionnaire pages throughout the procedure. Each food CS was labeled PICTURE A, while each body shape US was designated PICTURE B, with the US presented to the right of the CS. Under each CS-US pair, participants were asked to indicate the likelihood of PICTURE A being paired with PICTURE B by marking a cross on a visual analog scale measuring 100 mm, ranging from 0 (not at all likely) to 100 (extremely likely). The distance (mm) from the line's starting point to the marked cross provided a measure of expectancy regarding how likely participants believed each CS was to be paired with each UCS. Each A4 page contained two CS-US pairs and their corresponding visual analog scales.

The Dwyer et al. study (2007) had two main objectives, accomplished in two experimental studies. Experiment 1 aimed to test whether aversion to a neutral image created by combining it with a disliked image could be reduced by presenting the neutral image alone after conditioning. Accordingly, after the conditioning stage, the procedure included an extinction stage. During extinction, pre-conditioned CS stimuli were used. Notably, only half of the CS stimuli used for the entire procedure (4 out of 8) were subject to extinction.

The aim of Experiment 2 was to study the effects of cue competition in evaluative conditioning. Much of the procedure's components were taken from the previously discussed study by Lascelles et al. (2003), which showed an intense conditioning effect following the EC procedure, where picture stimuli presenting food (CS) and silhouette shapes (US) were used. Dwyer et al. (2007) conducted the project of two experiments. Both men and women participated in each. In the first experiment, 32 men and 32 women participated. The CS stimuli in the first study presented eight food images (apple, beans, bread, carrot, orange, green bell pepper, potato, and tomato).

In contrast, the US stimuli in the first experiment presented eight images of people selected based on body shapes. Four of the images showed obese people (two men and two women) being evaluated negatively, and four showed people presenting an average shape (two men and two women). Twenty-four participants (three men and 21 women) participated in the second experiment. The CS stimuli presented eight images of foods categorized as fatty (burger, donuts, fried breakfast, breaded fish, and French fries) vs. healthy (fruit salad, steamed beans, grilled chicken, green salad). The US stimuli presented six photos of women selected based on body shape: three obese vs. three average shapes.

The first phase of the first experiment involved participants evaluating 16 images of US body shapes and images of CS food. Each stimulus was displayed for 5000 ms. A message was displayed between each image for 5000 ms, asking them to rate the stimuli they had just seen on a scale of -100 (extreme dislike) to +100 (extreme liking). The next stage of the procedure was the conditioning phase, and the next stage was the extinction phase. Each CS image was consistently paired with a US image in the conditioning phase. The CS stimulus was displayed for 7000 ms; immediately after the CS was removed, the US stimulus was displayed for 7000 ms. There was an inter-trial interval (ITI) of 8000 ms between each CS-US pair. The CS-US stimulus pairs presented were displayed in three blocks of eight, so each pair was presented once per block. At the point when each CS-US pair was presented three times, the blanking phase began. Four CS food images were presented in this phase without their previously paired US. The CSs were presented in nine blocks of four images each so that each CS was presented once per block. Each image was displayed for 7000 ms with an ITI of 5000 ms. This experiment phase was followed by a postconditioning phase, in which participants evaluated the CS food images shown. As in the study's first phase, each CS image was displayed for 5000 ms, followed by a message for 5000 ms asking them to rate the stimuli they had just seen.

For the second experiment, the first phase involved participants evaluating 14 experimental stimuli: US images, showing female body shapes, followed by CS images, showing healthy vs. fatty foods (in the first experiment: 16 experimental stimuli-images of US body shapes and images of CS foods). This was followed by a conditioning phase in which each CS image was consistently paired with a US image. The CS-US pairs were presented in three blocks of six pairs so that each pair was presented once per block (in the first experiment, the stimuli were displayed in three blocks of eight pairs so that each pair was presented once per block). In the final phase of the experiment, participants were shown CS food images for evaluation.

The last article included in the review was conducted by Lebens et al. in 2011. The study aimed to test whether implicit measures of snacking associations and food consumer behavior could be altered using a picture-picture evaluative conditioning procedure. The project involved a pilot study and a target study. Twenty women participated in the pilot study (age: M= 35.05, SD = 17.08; BMI: M = 22.92, SD = 2.94). The purpose of the pilot was to assess the valence of photographs of female body shapes. Participants rated the shapes they thought were the most positive and the most negative. Forty-eight photos of women were selected for evaluation. When choosing images for evaluation, care was taken to ensure they were diverse in age, ethnicity, hair color, and skin color. During the pilot, the participants rated, using a VAS scale, (1) the attractiveness of the woman's body and (2) how much they would like to have such a body. Participants were then asked about the participant's age, height, and weight. The most positively and most negatively rated body shapes were then used as the US in the main EC procedure of the study. Eighty-five women participated in the main experiment. Each participant was randomly assigned to experimental conditions ($M_{age}$ = 34.14, $SD_{age}$ = 12.87) and control ($M_{age}$ = 34.23, $SD_{age}$ = 13.49).

As compensation for participation, six iPods were drawn among the participants. The CS stimuli were twelve food images: snacks (chips, chocolate, cookies, fries, hamburger, and pizza) vs. fruits (apples, grapes, kiwi, melon,

raspberries, and strawberries). The US stimuli were twelve images of female body shapes (six positive and six opposing bodies). In the first stage of the experiment, the EC procedure was used. At first, participants categorized the images by pressing one of two keys on the keyboard as instructed. To minimize awareness of the purpose of the study, the categorization involved the spatial location of the stimuli displayed on the monitor. The participant was told to press the "e-key" when he saw that the CS appeared in one of the two upper quadrants and the "i-key" when he saw on the screen that the CS appeared in one of the lower quadrants. Then, a female body shape (US) image appeared briefly (400 ms) in the same quadrant. This procedure was repeated for 144 trials with an intertrial interval of 1,500 ms.

Of the 144 trials, 72 displayed CS with snacks, and 72 displayed CS with fruit. Fruit images were always paired with body shapes of positive valence, and snack images were always paired with body shapes of negative valence. For the control group, the CS-US pairs were random. This meant that both CS snack and CS fruit stimuli were followed by display and US stimuli of positively valenced body shapes (50%) and negatively valenced body shapes (50%). After the conditioning procedure, participants performed the IAT. The IAT aimed to assess how much participants valued positive and negative fat content. Accordingly, participants were assigned to either an upbeat version of the IAT or a negative version. Each version consisted of three blocks. The first block involved practicing the categorization of attribute concepts (pleasant vs. neutral or unpleasant vs. neutral).

The second block was expanded to include the "snacks" category. The same six snack images used as CSs in the EC task were used as target stimuli. The target category (label: "snack") and valence attribute category were assigned to one response key, and the neutral attribute category to another (e.g., "e-key": snack + pleasant; "i-key": neutral). The third block differed from the second only by reversing the critical assignment for the target category. In this block, the target category was now paired with a neutral rather than a valued attribute category. The participant then proceeded to the virtual supermarket task. The participant was given a budget of 15 euros for the task. With this budget, the participant was to purchase food and beverages, the amount she would need if she did not leave home for a day.

The virtual supermarket was divided into main categories (e.g., vegetables, fruits, etc.), subcategories (e.g., fresh vegetables, canned vegetables, and frozen vegetables), and products (640 in total). After the participants confirmed that they had chosen everything they needed for the day, calories from snacks, calories from fruit, and total calories were calculated as dependent variables. To see if the participant was aware of the CS-US determinants in the EC procedure, an open-ended question was asked at the end of the study if they noticed anything typical about how the photos were presented. Finally, the participant's age, height, and weight were asked.

Although the reviewed studies differed substantially in specific procedural details, they shared a common evaluative conditioning framework based on repeated pairings of food stimuli with body silhouettes. Methodological variability primarily concerned with the number of conditioning trials, the inclusion of extinction phases, the gender composition of samples and unconditioned stimuli, and the type of outcome measures used. These differences reflect distinct research aims rather than inconsistencies in the core conditioning logic. To facilitate comparison, Table 2 summarizes the key methodological dimensions along which the studies can be meaningfully contrasted, with emphasis on shared structural features and higher-level procedural differences rather than fine-grained timing parameters.

**Quality assessment and potential sources of bias**

Although all studies included in the review addressed the evaluative conditioning paradigm, several potential sources of systematic bias should be noted. First, the study samples were composed predominantly of women, which

**Table 2.** Key methodological similarities and differences across studies included in the review

| Methodological dimension | Lascelles et al. (2003) | Dwyer et al. (2007) | Lebens et al. (2011) |
|---|---|---|---|
| Study design | Between-groups EC experiments (2 studies) | EC experiments with extinction and cue | EC experiment with implicit and behavioral outcomes |
| Sample | Female-only, nonclinical | Mixed-gender (Exp. 1), female-only (Exp. 2) | Female-only |
| Conditioned stimuli (CS) | Food images (single items) | Food images | Food images (snacks vs. fruits) |
| Unconditioned stimuli (US) | Female body silhouettes (obese, average, thin) | Body silhouettes (male and female; obese vs. average) | Female body silhouettes (positive vs. negative valence) |
| Number of conditioning trials | 18 | 18 (Exp. 2); 24 + extinction | 144 |
| Extinction phase | No | Yes (Exp. 1 only) | No |
| Outcome measures | Explicit ratings | Explicit ratings | Implicit (sc-IAT) and behavioral (virtual shopping) |
| Main conditioning effect | More negative evaluation of CS paired with obese US | More negative evaluation of CS paired with obese US | More negative implicit evaluations of snack CS |

limits the generalizability of the findings to both sexes. Second, the selection of stimuli and their standardization varied considerably across studies, particularly with respect to the sources, validation procedures, and categorization of body-shape stimuli. Third, none of the reviewed studies reported preregistration of hypotheses or analysis plans, thereby increasing the risk of selective reporting. Finally, the heterogeneity of outcome measures (explicit ratings, implicit tasks, and behavioral proxy indicators) hinders direct cross-study comparisons and constrains the interpretability of effect size patterns. These issues should be considered when drawing conclusions from the present review and when designing future evaluative conditioning research in the field of nutrition.

## DISCUSSION

The main objective of this systematic review was to examine the existing literature on EC that used food stimuli and body silhouettes (CS-US). A significant portion of the discarded studies considered food stimuli as CS but employed faces or other USs that did not meet inclusion criteria. In addition, previous studies that investigated food preferences used not only picture stimuli for US and CS but also, for example, smell or taste stimuli. Of the 162 articles reviewed, only three met the criteria for inclusion in the detailed analysis (Table 1). The typical features of the studies discussed above were the two types of CS-US stimuli used (food and body silhouettes) and the EC effect obtained. However, most other elements essential to the EC methodology and the choice of stimuli were different.

### Methodological elements

#### *Type of stimuli*

Although the types of US (body silhouettes) and CS (food) stimuli used were consistent across studies, it is important to note that the stimuli originated from different sources and varied in specific features. For instance, in the studies by Lascelles et al. (2003) and Lebens et al. (2011), US stimuli consisted solely of female silhouettes, whereas in the study by Dwyer et al. (2007), both female and male silhouettes were used. Additionally, there is a need for clarification regarding the sources of the US stimuli in the reviewed articles. Lascelles et al. (2003) and Lebens et al. (2011) indicated media as the source of the US stimuli. In conclusion, while the studies reviewed employed consistent types of US (body silhouettes) and CS (food) stimuli, the variation in the specific features and sources of these stimuli highlights the need for greater standardization in future research. The discrepancies in the gender representation of US stimuli and the lack of clarity regarding their origin may contribute to outcome inconsistencies. They should be addressed to improve the comparability and reliability of findings within the evaluative conditioning paradigm.

Also, the evaluation of US stimuli in the two pilot studies was done differently. In the case of the Lascelles et al. (2003) study, the evaluation was done by an experimenter, and in the case of the Lebens et al. (2011) study, by a group of women. Noteworthy, the category of silhouettes included in the studies was different. In the case of the Lascelles et al. (2003) study, three categories of female silhouettes were presented: obese, average, and slim. In the study implemented by Dwyer et al. (2007), in the first study, US stimuli represented both female and male silhouettes in two categories: average vs. obese, while in the second study, US stimuli presented only female silhouettes: average vs. obese. In the Lebens et al. (2011) study, as in the Lascelles et al. (2003) study, US stimuli presented only female silhouettes but were divided into positive and negative categories.

In addition to differences in US stimuli, CS stimuli varied from study to study**.** Although the type of stimuli was still the same food, it is worth noting that the studies differed as to whether the CS stimulus was a single product, e.g., an apple, or a category of products classified, for example, as healthy unhealthy foods, e.g., oatmeal/ pizza, or high fat vs. low fat. It is also worth mentioning that the number of US and CS used differed in each experiment.

#### *Measurement of conditioning effects*

When assessing the effect of EC in the Lascelles et al. (2003) study, the CS and US stimuli were presented in a randomized order. In addition, participants scored on a scale measuring obesity, which was presented to them in the form of an A4 printout of a US image. In the Dwyer et al. (2007) study, the postconditioning phase involved rating eight foods on a scale ranging from 100 (extreme dislike) to 100 (extreme liking). Each CS was displayed for 5000 ms, followed by a message asking them to rate the stimuli they had just seen, which was shown for 5000 ms. The Lebens et al. (2011) study evaluated the EC procedure through each participant's shopping task within a virtual supermarket.

In conclusion, the variety of methods used to measure the effects of evaluative conditioning in these studies highlights both the strengths and limitations of current approaches. Randomized stimulus presentations, detailed rating scales, and immersive tasks like virtual shopping provide valuable insights into how conditioned associations can shape food preferences and attitudes. However, these methods also have drawbacks, such as potential biases introduced by the artificial nature of the tasks or the limited ecological validity of some scales. Thus, while these tools are instrumental in advancing our understanding of evaluative conditioning, continuous refinement is needed to ensure that measurements accurately reflect real-world behaviors and attitudes.

### CS evaluation and Conditioning procedure

#### *Timing*

Lascelles et al. (2003) and Dwyer et al. (2007) report pilot studies conducted on US stimuli and a preconditioning evaluation of CS stimuli. In the case of Lascelles et al.

(2003), the procedure itself was less thoroughly reported than in the case of Dwyer et al. (2007), where CS stimuli as well as US stimuli were evaluated on a scale ranging from 100 (extreme dislike) to 100 (extreme liking). The study by Lebens et al. (2011) did not provide information on preconditioning. In contrast, only US stimuli were assessed in the pilot study.

Analysis of the articles in the systematic review also revealed differences in the EC procedure for each experiment. The parameters were the same for Lascelles et al. (2003) and Dwyer et al. (2007). In study one, for Lascelles et al. (2003), in the experimental group, each CS was presented for 7000 ms followed by an ISI of 200 ms, and the corresponding US was then presented for 7000 ms followed by an ITI of 8000 ms. The CS and US stimuli were not presented in pairs in the control group, where CS was presented first, followed by another CS instead of the US. These independent CS-CS pairs were presented repeatedly until the total number of presentations of a given CS was the same as the total number of presentations in the experimental group. Each stimulus was presented for 10,500 ms, followed by an ISI of 300 ms, and then the presentation for another 10,500 ms, followed by an ITI of 12,000 ms. In the case of the Dwyer (et al., 2007) study, which was based on the Lascelles et al. (2003) case study, the CS was presented for 7,000 ms, and immediately after removal of the CS, the US stimulus was presented for 7,000 ms. There was an intertrial interval (ITI) of 8000 ms between each pair of CS US. However, It is worth noting that Experiment II in the Lascells et al. (2003) study differed from the Dwyer et al. (2007) study for both reports.

***Trials***

In the Lascelles study, participants in the experimental condition were exposed to 6 CS-US pairs during the acquisition phase. Each pair was presented thrice, resulting in 18 trials (6 pairs × three presentations per pair). In Dwyer's first experiment, participants were exposed to 8 CS-US pairs during the conditioning phase. Each pair was presented three times, leading to 24 trials (8 airs × 3 presentations). Following this, an extinction phase was introduced, during which 4 of the CSs (two associated with obese UCS and two with normal UCS) were presented across 36 trials (4 CS × 9 presentations). In Dwyer's second experiment, participants were presented with 6 CS-US pairs (three with obese US and three with normal US). As in the previous studies, each pair was presented three times, resulting in 18 trials (6 pairs × 3 presentations). The primary difference between the studies lies in the number of trials and the inclusion of additional phases. While Lascelles and Dwyer's second experiment used 18 trials during the acquisition phase, Dwyer's first experiment included a more extensive extinction phase, increasing the total number of trials. This distinction highlights Dwyer's focus on examining the acquisition of associations and their extinction, in contrast to Lascelles, who concentrated on the acquisition phase.

In contrast, the study by Lebens et al. (2011) revealed differences in stimulus presentation times, but these are unclear. Namely, while the report included information on the display time of the US stimulus (400 ms), no information was explicitly provided on the US stimuli. The image of the female body shape (US) appeared. The interval between CS-US trials, on the other hand, was 1500 ms. There were 144 trials alone, where 72 displayed CS with snacks, and 72 displayed CS with fruit.

***Extinction***

The EC extinction phase was recorded in one of the three reports analyzed. In the article by Dwyer et al. (2007), the extinction phase began immediately after the conditioning phase. The four CS food images were presented individually without the US in nine blocks. This meant that each CS was presented once per block. Each image was displayed for 7000 ms with an ITI of 5000 ms. Also, there was no CS measurement between conditioning and extinction. That makes it impossible to assess both conditioning and extinction effects.

**Results: Similarities and Differences – Analysis**

***Pre-conditioning Rating***

The pre-conditioning stages for the studies conducted by Lascelles et al. (2003) and Dwyer et al. (2007) were comparable, focusing on CS and US stimuli ratings. In the study by Lebens et al. (2011), pre-conditioning ratings were not reported, as the emphasis was on results and their interpretation measured through the positive and negative unipolar Implicit Association Test (sc-IAT).

For the studies by Lascelles et al. (2003) and Dwyer et al. (2007), the results indicated no differences in the pre-test ratings of food (US stimuli). Both studies found no significant differences in food ratings across different conditions before conditioning, with F-values below 1, indicating no significant effects. In Dwyer's study, both experiments showed that pre-conditioning food ratings were identical, except for slightly higher values for fatty and healthy products in the second experiment. However, the effect did not reach significance. Regarding US stimuli in both studies, significant differences were found between the ratings of obese and normal body shapes. Lascelles et al. (2003) reported a significant difference between the ratings of obese, regular, and thin bodies, confirmed by high t-values and low p-levels ($p < 0.001$). Similarly, Dwyer et al. (2007) found significant pre-conditioning differences in ratings of obese and normal body shapes, with high F-values and low p-levels ($p < 0.001$).

The differences revealed by both studies mainly pertain to main effects and interactions. Lascelles et al. (2003) found significant main effects for US stimuli, indicating that obesity ratings differed significantly between stimuli depicting obese, average, and thin body shapes. However, no significant main effects or interactions were found for other variables. In Dwyer's study, the first experiment found no significant effects or interactions except for minor main effects of weight, US, and

extinction (F < 2). In the second experiment, the effect of the type of CS did not reach significance, and the only interaction nearing significance was between the type of training and US weight (F = 1.1).

### *Differences between Pre- and Post-conditioning Ratings of the CSs*

Comparing the conditioning stages in the studies by Lascelles and Dwyer revealed similarities and differences in the ratings of stimuli. Regarding similarities, both studies observed decreased CS ratings paired with obese US and no significant interaction effects. The decrease in ratings was noted in both Lascelles et al. (2003) and Dwyer et al. (2007), where the ratings of conditioned stimuli (CS) paired with images of obese body shapes decreased after conditioning compared to pre-conditioning ratings. In Lascelles' study, the ratings of CS paired with the obese US dropped from M = 28.67 (SE = 4.70) before conditioning to M = 23.30 (SE = 4.77) after conditioning. In Dwyer et al. (2007) first experiment, a similar decrease in ratings for CS paired with obese body shapes was observed, while the ratings for CS paired with regular body shapes remained stable or slightly increased. In the second experiment by Dwyer et al. (2007), fatty and healthy CS paired with images of obese body shapes showed a more significant decrease in ratings post-conditioning compared to products paired with regular body shapes.

Regarding the lack of significant interaction effects, both studies reported no significant interaction effects in the post-conditioning stimulus ratings. Lascelles et al. (2003) found no significant interaction effects between the type of US, time (pre- vs. post-conditioning), and conditions (experimental vs. control BSB). In Dwyer's study, no significant interactions were found between within-group and between-group factors in both experiments.

The studies by Lascelles et al. (2003) and Dwyer et al. (2007) also revealed some significant differences concerning changes in ratings of CS paired with average and/or thin US or effects obtained in control conditions. Regarding rating changes, Lascelles et al. (2003) found no significant changes in the ratings of CS paired with average and thin UC after conditioning compared to pre-conditioning ratings. In Dwyer et al. (2007) first experiment, the ratings of CS paired with images of standard body shapes remained stable or slightly increased, while in the second experiment, these ratings were more stable compared to CS paired with obese body shapes. Lascelles et al. (2003) observed no significant differences in ratings before and after conditioning in control conditions, suggesting no impact of conditioning in these conditions. In Dwyer et al. (2007), control conditions were not explored analogously, focusing primarily on conditioning effects in experimental conditions.

## LIMITATIONS AND FURTHER IMPLICATIONS

Undoubtedly, the line of research using food stimuli as CS and US stimuli presenting body silhouettes should be further explored, first, regarding new research on nutrition and related topics under discussion. Second, research will focus on the cognitive and methodological aspects of the EC mechanism using these two categories of stimuli. Meanwhile, the studies discussed have limitations, which may inspire new research. The articles selected for review show that while topics related to nutrition eating are increasingly being studied using EC, as in other paradigm-driven and attitudinal studies, there is a certain lack of methodological continuity and expansion of known studies to include other relevant variables (Dwyer et al., 2007; Lebens et al., 2011). Indeed, an argument that can explain the above findings is the researchers' reliance on analyzing explicit and implicit attitudes toward eating behavior. Researchers are constantly analyzing which of these, i.e., whether implicit or explicit attitudes, are better predictors of dietary choices in the context of healthy food preferences and the prevention of obesity and diseases caused by poor eating habits (Hensels et al., 2016). According to researchers, eating is an automatic and habitual mechanism (Naughton et al., 2015; Hensels et al., 2016). For this reason, it is often postulated that eating behavior should be analyzed through associative processes and implicit attitudes. On the other hand, as research results on eating behavior show, EC influences explicit attitudes toward food (Holland et al., 2011; Walsh & Kiviniemi, 2014).

Notably, the silhouette stimulus category used in the Lascelles et al. (2003), Dwyer et al. (2007), and Lebens (2011) study has also been used in studies on the effect of exposure and making social comparisons. For example, a study by Dignard & Jarry (2021) on body satisfaction, state appearance comparison, and positive body image revealed that women who viewed body silhouettes as slim and muscular showed less body satisfaction than women who viewed travel photos. Another study by Fioravanti et al. (2021), which followed an experience sampling method over 28 consecutive days, found that daily exposure to positive body images was associated with the highest increase in positive mood and body satisfaction. In contrast, daily exposure to images depicting muscular silhouettes was associated with the highest negative mood and appearance comparison increase. The results of a systematic review by Jerónimo & Carraça (2022) showed that exposure, or presentation, of images depicting muscular body silhouettes during the study, led to increased body dissatisfaction by those viewing the images. The review results also showed a link between body dissatisfaction and negative mood in the subjects. At the same time, researchers should carefully consider how body-related stimuli may activate culturally shaped norms and stereotypes, including those related to gender, physical appearance, and social desirability (Faragó et al., 2022). Such stimuli may evoke evaluative meanings that extend beyond health-related associations and differ systematically across cultural and social contexts. Explicit reflection on these processes is therefore essential to ensure that evaluative conditioning procedures do not inadvertently reinforce body dissatisfaction, weight stigma, or gender-based stereotypes (Farrow & Tarrant, 2009).

From an ethical perspective, greater transparency in stimulus selection and increased diversity in body representations may help mitigate these risks. Based on exposure, subjects' tendency to make comparisons of individuals' bodies with those shown in images was identified as a reason for the increase in body dissatisfaction. Notably, many studies included in the review used stimuli of muscular silhouettes and fragile ones. In addition, the review included both studies conducted on a group of women and men, presenting similar results. The studies described in this review used silhouette stimuli presenting either slim or obese silhouettes in their methodology. In contrast, the exposure and comparison studies more often used stimuli presenting muscular and lean body silhouettes. Given the findings to date, it seems natural that one possible avenue for exploring the silhouette stimulus category is to implement research using methodological assumptions and procedures that combine the research on conditioning with the line on the exposure effect and making social comparisons.

The results of the systematic review presented above revealed that although it can be generally assumed that the stimulus categories used in the studies were the same, they differed in objectives, selection of stimuli, procedure, or the evaluation of the study effects. The different objectives may have influenced the changes made in procedures. However, studies by Lascelles (2003) and Dwyer (2007), for example, showed that despite the different objectives, elements of the procedures were kept the same or very similar. In the case of stimuli, it is noteworthy that although the stimulus categories were the same, at least in the case of CS stimuli, the studies presented both stimuli presenting a single food item (apple) and whole meals (oatmeal). This systematic review also revealed that the studies differed in the valence ratings made after the EC procedure against the stimuli.

The studies differed not only methodologically but also in terms of technical elements in study design. Most of the identified studies were likely to have female participants **(**Lascelles et al., 2003; Lebens et al., 2011). While this makes sense, due to the choice of stimuli, both the topics of nutrition and eating disorders, as well as assessment of one's appearance, are currently being studied equally among women and men. In general, EC research considers both groups: women and men. (Gawronski et al., 2015; Hollands & Marteau, 2016; Walsh & Kiviniemi, 2014). It is worth ensuring that when carrying out similar procedures or replicating the above studies, men should also be included, as was done in the study of Dwyer et al. (2007). This may contribute to a greater exploration of individual differences in the objectives of the above studies and the possibility of greater generalization of the results obtained. Likewise, it would be worth ensuring that researchers keep the same thing in mind for future studies when evaluating the stimuli used, i.e., that the evaluation is done equally by women and men.

At the same time, for future studies, it is also worthwhile to better document the sources of the stimuli used for replication purposes. Moreover, current trends regarding EC focus on the potential role of mediators and moderators in the attitude formation process (Casini et al., 2023). Body silhouettes may be interpreted in multiple ways: a slim female figure may signal health, self-control (Webster & Tiggemann, 2003), or cultural ideals (Abdoli et al., 2024), but it may also evoke appearance-related or erotic meanings (Paslakis et al., 2022). Disentangling these interpretations is crucial for mechanism-focused explanations of EC effects and for designing ethically responsible applications (Hollands et al., 2011; Zerhouni et al., 2019; Ruszpel & Gast, 2020). Future studies should therefore measure participants' interpretations of US stimuli and test whether these meanings mediate changes in food evaluations.

## ETHICAL CONSIDERATIONS

It is also worth mentioning that using human silhouette stimuli to study eating preferences is controversial. First, the judgments attributed to body images can be influenced by many factors, including peer pressure, media use, and the social messages presented there (Hensels et al., 2016). Because of this, the cognitive, emotional, and affective components of attitudes regarding body images are complex, and it is difficult to assess whether they are unambiguously positive or negative (Lascelles et al., 2003). Second, there are speculations that the US body and CS of food may be interdependent, so evaluating different body images is likely linked to several beliefs and attitudes related to food and health (Hensels et al., 2016).

The use of human body silhouettes as unconditioned stimuli raises important ethical considerations. Body-related images can activate stigma and culturally reinforced stereotypes linked to weight, gender, attractiveness, and self-control (Major et al., 2014). In particular, the frequent use of female silhouettes may unintentionally reinforce gendered appearance norms or contribute to body dissatisfaction in vulnerable participants. Future research should therefore justify stimulus choices explicitly, assess potential adverse effects (e.g., affect, body dissatisfaction), and consider more diverse and inclusive stimulus sets to reduce the risk of reinforcing harmful social standards (Aspen et al., 2015).

## PRACTICAL IMPLICATIONS

The findings suggest that evaluative conditioning may be useful for modifying food-related attitudes, potentially complementing interventions that rely primarily on conscious deliberation. Accordingly, possible applications include nutrition education, the development of public health communications, and strategies aimed at counteracting the effects of unhealthy food advertising. However, practical implementation requires careful evaluation of effectiveness, durability, and ethical acceptability, particularly when employing stimuli related to body shape and physical appearance. Importantly, evaluative conditioning effects may occur even in the absence of explicit

awareness of stimulus pairings, highlighting the potential relevance of this approach for influencing automatic and habitual aspects of food-related attitudes (Demartini et al., 2019).

## CONCLUSION

To the best of our knowledge, this is the first systematic review to assess the existing literature on EC, in which the CS stimuli used for the procedure were food-presenting stimuli, and the US-presented body silhouettes. The review revealed both similarities and differences in the EC procedure. Two of the three reports included in the review were methodologically similar in that the second replicates the first. The third report, on the other hand, had utterly different methodological assumptions. It seems reasonable to continue the line of research reviewed above, both in terms of replication and the research extensions proposed in this review.

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