The Influence of Emotion on Eating Behavior: Theories and Mechanisms

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Abstract

Human eating behavior is influenced by numerous factors, including physiological, psychological, and sociocultural factors, among which the impact of emotion on eating behavior has increasingly attracted researchers' attention. This influence is generally manifested in the amount of intake and the selection of food (caloric content). Through examining the manifestations of food intake in clinical and non-clinical individuals under different emotional states, research has summarized that negative emotions are more likely to lead to binge eating in individuals. Research findings on eating behavior under the influence of positive emotions are divided: from a physiological perspective, it is explained that positive emotions can promote individuals' hedonic mechanisms, leading to increased eating behavior; whereas self-control theory posits that positive emotions increase personal resources to resist the temptation of palatable food. Furthermore, the neurophysiological mechanisms of eating behavior under emotional influence have been further explored. In future clinical research and treatment related to eating, there is a need for deeper investigation into the neural mechanisms underlying emotion-influenced eating behavior.

Full Text

The Influence of Emotion on Eating Behavior: Theory and Mechanism

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Abstract: Human eating behavior is influenced by numerous factors, including physiological, psychological, and sociocultural elements. Among these, the impact of emotion on eating behavior has garnered increasing attention from

researchers. This influence generally manifests in both the quantity of food intake and the selection of specific foods (particularly their caloric content). By examining food intake patterns in clinical and non-clinical populations under different emotional states, research has consistently shown that negative emotions are more likely to lead to binge eating. However, findings regarding eating behavior under positive emotions remain divided: from a physiological perspective, positive emotions may activate hedonic mechanisms that increase consumption, whereas self-control theory suggests that positive emotions augment personal resources to resist food temptations. Furthermore, this paper explores the neurophysiological mechanisms underlying emotion-influenced eating behavior. Future directions for diet-related clinical research and treatment should involve deeper investigation into the neural mechanisms of eating behavior under emotional influence.

Keywords: positive emotions, negative emotions, eating disorders, binge eating

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In today' s world, material resources are abundant, and countless delicacies fill streets and alleys. People are adept at exploring and eager to choose flavors they enjoy. Three daily meals provide essential energy and are indispensable. Undoubtedly, food is vitally important to humans—not only as a physiological necessity but also as a tremendous source of pleasure and meaning in life (Barnhill & Doggett, 2018). From infancy, individuals develop specific food preferences, which result from feedback from primary sensory organs (Maier-Nöth, 2019). Berridge (2009) refers to this preference as food reward, which serves as the driving mechanism for most people' s food choices. However, beyond primitive sensory drives, other factors influence food selection, including personal goals (Kleiman et al., 2016), illness (Werthmann et al., 2019), and emotion (Donofry et al., 2019). Emotion possesses motivational functions and plays a crucial role in regulating organisms' fundamental behaviors (Izard & Ackerman, 2000). Emotion can influence individuals' eating behavior, and conversely, food consumption can affect people' s emotions (Czepczor-Bernat & Brytek-Matera, 2021; Du et al., 2019). Unhealthy eating behaviors influenced by emotion can trigger a series of health problems and even diseases. A survey investigating the relationship between childhood exposure trauma and emotional eating found that obesity, stress, and related unhealthy outcomes from exposure trauma may be directly associated with coping strategies accompanied by emotional dysregulation (Michopoulos et al., 2015). Clinical research has also confirmed that unreasonable emotion regulation plays a role in maintaining symptoms of eating disorders (Prefit et al., 2019). Therefore, understanding how emotion influences individual eating behavior is crucial for exploring eating habits and health status.

Early researchers focused primarily on how negative emotions affect food choice (Stice et al., 2005), labeling eating under negative emotions as “emotional eating” (Spoor et al., 2007). In recent years, research using different assessment methods to explore eating behavior under negative emotions has matured, yielding

largely consistent conclusions about negative emotions influencing food choice. A meta-analysis examining eating behavior under both positive and negative emotions found a causal relationship between negative emotions and increased food intake (Cardi, Leppanen et al., 2015). However, no consensus has been reached regarding the characteristics and physiological mechanisms of eating behavior under positive emotions, and few studies have systematically elaborated on the influence of emotion on eating behavior under both clinical and non-clinical conditions. Based on existing research, this paper summarizes and analyzes the patterns of emotion' s influence on food choice from behavioral and neurophysiological perspectives, hoping to provide a reference for future research on the relationship between emotion and eating behavior.

2. General Manifestations of Emotion's Influence on Eating Behavior

Non-clinical research on food and emotion generally focuses on obesity, body dissatisfaction, and healthy populations (Cardi, Leppanen et al., 2015), while evaluations of eating behavior are typically determined through intake quantity, attentional bias, subjective reports, and other physiological indicators (Koster & Mojet, 2015). Studies on food and emotion build upon food-related research paradigms by further inducing emotions in participants to measure their food choices. One study assigned participants to different scenarios of social rejection, neutral conditions, and social inclusion, then conducted a bogus taste test with all participants, finally measuring their ice cream intake. Results showed that participants in the social rejection condition consumed more ice cream than those in neutral and social acceptance conditions (Sproesser et al., 2014). Another study used a food Stroop paradigm to explore participants'eating behavior under emotional induction and the role of negative oppression, requiring participants to complete tasks including a classic Stroop task, a food Stroop task, an invitation-to-eat task, and questionnaires. In the food Stroop task, participants judged the colors of emotional food words (e.g., chocolate) and neutral animal words. Results revealed that food intake after negative emotion induction was related to negative emotional arousal but not to food attentional bias; emotional arousal and valence did not increase participants' attentional bias toward food (Becker et al., 2016).

Negative emotion is one of the most powerful predictors of self-regulation failure, promoting the shift of attentional and cognitive resources from long-term goals to immediate goals of alleviating negative emotions (Heatherton & Wagner, 2011). Self-regulation failure caused by negative emotions can produce many risky behaviors, such as drug use, alcohol abuse, and uncontrolled eating (Heatherton & Wagner, 2011). A meta-analysis of over a dozen studies on food intake under negative emotions found that participants induced with negative emotions (e.g., watching sad film clips) consumed more food in subsequent snack flavor evaluation tests (requiring participants to taste various chocolates, chips, or ice cream and rate them, though the real purpose was measuring sam-

ple intake) (Cardi, Leppanen et al., 2015). Animal experiments also provide evidence for eating behavior induced by negative emotions. One study placed Syrian male hamsters in the cages of larger, trained animals for 7 minutes daily over 4 days, creating social defeat, and found that the hamsters' food intake increased significantly (Solomon et al., 2006). In another study on rats and healthy participants, rats given chronic mild stress showed better performance when obtaining high-sweetness rewards after depression induction. Similarly, participants induced with negative emotions through life events also increased their intake of raisins and chocolate (Aguiar-Bloemer & Diez-Garcia, 2018).

However, several studies found that women did not consume more food under negative emotion influence (Bongers et al., 2013; Evers et al., 2010; Le, 2019). This may be because most studies overlooked women's qualities and their degree of identification with social standards—an intragroup difference. A recent study analyzing women' s food intake under negative emotion induction found that more modest women actually reduced their food intake under negative emotions. The possible reason is that the tendency to devalue self-achievement caused by humility is related to moderate behavior; women may reduce food intake to maintain a stable and moderate image, or because the low self-control and untidy image associated with overeating is inconsistent with their humble behavioral goals (Le, 2019). Therefore, research focusing on emotion and eating may need to consider additional factors such as gender.

Unlike negative emotions, the influence of positive emotions on eating behavior remains controversial. Some researchers argue that the extensive focus on negative emotions causing binge eating has overlooked that positive emotions can also trigger excessive intake of delicious foods, with an impact equivalent to that of negative emotions (Juergensen & Demaree, 2015; Macht, 2008). One study induced positive or negative emotions in 64 healthy female participants through music; subsequent snack flavor evaluation results showed that participants in the positive emotion condition consumed more food (Collins & Stafford, 2015). Otake and Kato (2017) discovered the relationship between positive emotions (subjective well-being) and food intake through three experiments: a questionnaire survey of 1,299 Japanese university students found that participants with higher subjective well-being were more inclined to obtain pleasure through eating; the second study asked participants with high and low subjective well-being to rate the emotional experiences brought by delicious foods, finding that those with higher well-being had more positive emotional experiences toward delicious food pictures; the third study replaced food pictures with real food and found the same results—participants with high subjective well-being showed stronger positive emotions toward real food stimuli.

However, the conclusion that positive emotions increase food intake appears uncertain, with some studies showing reduced eating (Turner et al., 2010) or unchanged intake (Yeomans & Coughlan, 2009) under positive emotions. One study used film clips to induce positive or neutral emotions in 365 college students, followed by a choice between high-calorie, highly tempting chocolate and

low-calorie raisins. Results showed that participants in the positive emotion condition were better able to resist temptation and consumed fewer chocolate beans compared to those in neutral or high-arousal conditions (Fedorikhin & Patrick, 2010). Another study explored eating behavior in eating disorder patients and healthy participants under positive emotion induction using an AB/BA crossover design, having participants undergo a 15-minute snack flavor test under positive or neutral emotion induction on the same day and time one week apart. Results found no significant difference in food intake between neutral and positive emotion conditions for healthy participants (Cardi, Esposito et al., 2015).

3. Clinical Characteristics of Emotion's Influence on Eating Behavior

Anorexia Nervosa, Bulimia Nervosa, and Binge Eating Disorder are all clinical eating disorders characterized by excessive or restricted food intake and loss of control over eating behavior (DSM-5, American Psychiatric Association, 2013). The onset and symptoms of these diseases are related to emotion (Prefit et al., 2019; Williams-Kerver & Crowther, 2020), and unreasonable eating behaviors in patients with eating disorders (such as binge eating and dietary restriction) may serve to regulate negative emotions (Brockmeyer et al., 2014).

Bulimia Nervosa and Binge Eating Disorder are characterized by consuming large amounts of food within discrete periods. Bulimia Nervosa involves recurrent inappropriate compensatory behaviors to prevent weight gain (such as self-induced vomiting, excessive exercise, and laxative abuse), while binge eating episodes in Binge Eating Disorder are not associated with compensatory behaviors (Diagnostic and Statistical Manual of Mental Disorders-5; DSM-5). The emergence of these core symptoms may result from deficits in emotion regulation and impaired inhibitory control (Danner et al., 2014; Svaldi et al., 2014), and because behavioral impulses cannot be separated from the environment, inhibitory control may be influenced by negative emotions (Sharma et al., 2014). Researchers used a food-related anti-saccade task to measure inhibitory control, conflict processing, and self-monitoring in binge eating patients. In the experiment, stimuli (food or non-food pictures) appeared randomly on the left or right side of the screen, and participants were instructed to avoid looking at the stimulus side and instead fixate on the side without the stimulus. Results showed that binge eating patients had significantly higher error rates on their first saccade than the control group, and patients with Binge Eating Disorder showed more initial fixation bias toward food stimuli under negative emotions, indicating that their inhibitory control ability may be affected by negative emotions (Leehr et al., 2018). Bulimia Nervosa patients also show altered inhibitory control under emotional influence. Researchers used event-related potential (ERP) technology to measure attention to high- and low-calorie food pictures in bulimia patients under negative and neutral emotion induction, while also measuring appetite and pleasure from food. Results showed that compared to healthy participants,

bulimia patients had stronger eating desires under negative emotion induction, and simultaneously showed reduced P300 amplitude (an ERP component representing motivational attention allocation) when viewing high-calorie foods under negative emotion induction, suggesting that negative emotions reduce the availability of cognitive resources in bulimia patients, thereby increasing food cravings (Lutz et al., 2021).

Anorexia Nervosa is currently the eating disorder with the highest mortality rate (Fichter & Quadflieg, 2016), primarily characterized by restrictive eating, irrational thinking, preoccupation with food, and body image disturbance (Glashouwer et al., 2019; Schaumberg et al., 2017). Additionally, anorexia patients exhibit difficulties in emotion regulation, which is considered a primary cause of eating disorders (Aviram-Friedman et al., 2018; Innamorati et al., 2017). Early research found that fear emotions in anorexia patients were related to food calories (Ellison et al., 1998). A study using a monetary reward task (Wheel of Fortune) with healthy participants and anorexia patients found that anorexia patients who did not win monetary rewards had poorer adaptation to negative emotions (Piccolo et al., 2019). Meule et al. used questionnaires to investigate eating patterns in anorexia patients under different emotional states, finding that anorexia patients experienced high negative emotions and ate less than usual under negative emotions but more under positive emotions (Meule et al., 2019). Another study using ecological momentary assessment found that in anorexia patients, higher negative emotions on one day were associated with a greater likelihood of restrictive eating the next day (Engel et al., 2013).

4. Theoretical Models of Emotion' s Influence on Eating Behavior

The relationship between eating behavior and emotion is complex. Early psychosomatic theories interpreted excessive eating as a state accompanied by physiological connections between negative emotions and hunger-satiety signals. Additionally, Slochower (1983) believed that individuals who frequently engaged in "emotional eating" had poor emotional adaptation and defective internal cognitive and emotional structures, particularly showing diffusion of negative emotions. Kaplan and Kaplan (1957) divided emotional states into uncontrollable and controllable states—the former being states individuals can perceive but cannot change, the latter being states individuals can change. For obese participants in anxiety states, those in uncontrollable anxiety states increased eating behavior, while those in controllable anxiety states did not. In recent years, psychologists have explained manifestations of emotion' s influence on eating behavior from different perspectives.

4.1 Five-Factor Model

Considering individual traits and emotional characteristics, Macht (2008) proposed five patterns of emotion' s influence on eating behavior: (1) Emotional

control over food choice, where emotions evoked by food stimuli affect food selection; (2) Emotion suppressing food intake, where high arousal or intense emotions due to emotional conflict inhibit eating; (3) Cognitive deficits affecting dietary control, where in restrained eaters, both negative and positive emotions increase food intake due to impaired cognitive control; (4) Eating regulating emotion, where in emotional eaters, negative emotions trigger the tendency to regulate through eating, increasing intake of sweets and high-fat foods; (5) Emotion congruence improving eating behavior, where in normal eating, emotions' influence on eating is consistent with their cognitive and motivational characteristics.

These five patterns identify functional principles between emotion and basic biological motivations—conflict, coexistence, and regulation—through antecedent conditions, eating responses, and mediating mechanisms, concluding that changes in eating under emotional influence may result from emotional interference, being byproducts of emotion, and outcomes of emotion regulation processes (Macht, 2008). While this model can explain why eating behavior decreases under negative emotion induction, it cannot explain why eating behavior increases under negative emotions in normal populations. Moreover, explaining emotion' s influence on eating behavior purely from different emotional functions and individual characteristics seems to overlook individuals' evaluation of and sensitivity to food under emotional influence. Some researchers have approached this from the perspective of emotion influencing food value, proposing a reward model of emotion' s influence on eating behavior.

4.2 Reward Model

Some researchers propose that overeating may also be an addictive behavior because both share similar regulatory mechanisms, such as viewing tempting food cues as having reward value (Loxton & Tipman, 2017; Ziauddeen & Fletcher, 2013). Baker et al. (2004) emphasized in their negative reinforcement model of drug addiction that addictive behavior occurs primarily to escape or avoid negative emotions, and when negative emotions increase, information processing may become biased toward addictive behaviors. Therefore, according to this model, some researchers believe that negative emotions increase the reward value of appetitive stimuli (e.g., food or drugs), leading to increased craving and attentional bias toward stimuli (Hepworth et al., 2009). Animal neuroscience research has found that distress simultaneously inhibits prefrontal control of behavior, subsequently producing sensitivity to threat stimuli and reward systems (Arnsten, 2009; Piazza & Le Moal, 1996).

If negative emotions make the brain' s reward system more sensitive to food and drugs, then brain regions representing appetitive reward in individuals must be involved in processing, such as the orbitofrontal cortex and striatum (Lopez et al., 2019). Therefore, researchers used functional magnetic resonance imaging (fMRI) to investigate this. Results showed that compared to neutral emotion conditions, participants under negative emotion induction showed significantly

increased orbitofrontal cortex activity when facing tempting foods, demonstrating that negative emotions can make the brain' s reward system more sensitive to appetitive cues and providing evidence for the relationship between negative emotions and disinhibited eating (Dylan et al., 2012).

4.3 Social Culture and Environment Theory

While the reward mechanism seems to clarify the internal mechanism of emotion-influenced eating behavior, eating behavior in social environments is inevitably affected by environment and culture. From a sociocultural perspective, the relationship between emotion and eating behavior may be an associative learning mechanism, where increased eating behavior is associated with positive emotions (Patel & Schlundt, 2001). Regardless of culture, food is unquestionably used to celebrate special occasions. For example, birthdays are usually accompanied by positive emotions, with people enjoying delicious food while offering blessings. Similarly, in sacrificial activities, people present the best food to nature with sincere hearts, then share it with companions—these emotions and eating behaviors may have become intrinsically linked (Monaco & Bonetto, 2019). Other researchers have discovered from the close relationship between social interaction and eating behavior that food intake increases when eating with acquaintances or good friends because mealtime extends in such environments, and the genuine happiness and enjoyment from dining with friends facilitate eating (Wansink, 2004).

Emotion also guides individuals to search for goal-related information in their environment; for example, positive emotions can signal that the environment is benign and safe (Andrade, 2005). Therefore, individuals' attention may bias toward stimuli that provide immediate rewards to gather more resources (Gupta, 2019). In eating behavior, this manifests as individuals focusing on short-term hedonic goals rather than long-term goals of health or maintaining a slim figure (Dingemans et al., 2009). This theory has received empirical validation: when individuals experience highly positive emotions, they are more inclined to engage in risky behaviors such as drinking, drug use, and binge eating (Kim & Kwon, 2019; Weiss et al., 2018). Sociocultural conclusions about emotion' s influence on eating behavior can explain most external manifestations, but individuals' own goals and attitudes also play a critical role.

4.4 Self-Related Theory

Theory based on human research suggests that the reason emotional distress leads to self-regulation failure is that it reduces individuals' self-awareness and limits attention to the surrounding environment (Heatherton & Baumeister, 1991). This reduction in self-awareness may cause individuals to focus on short-term hedonic goals (e.g., delicious food) rather than long-term self-monitoring goals. From an individual perspective, people enjoy pleasurable eating, especially under positive emotions. Increasing food consumption seems to be driven by pleasure rather than just caloric needs. Beyond concerns about weight and

health, abundant food resources may create an appetite equivalent to other hedonic activities (such as drug use and gambling), a phenomenon called "hedonic hunger" (Lowe & Butryn, 2007). Negative emotions resulting from emotion regulation failure may also weaken individuals' self-inhibitory control abilities, thereby strengthening the likelihood of eating behavior (Byrne et al., 2020).

On the other hand, research on self-licensing describes how people actively seek reasons to justify dietary indulgence (De Witt Huberts et al., 2012), and emotion seems to be a well-known cue among these reasons. The broaden-and-build theory posits that positive emotions increase personal resources, making subsequent challenges (such as resisting delicious food) easier to achieve (Fredrickson, 2001). According to mood maintenance theory, positive emotions seem to alleviate indulgent eating behavior because people are unwilling to destroy their positive emotions through indulgence (Andrade, 2005).

5. Physiological and Neural Mechanisms of Emotion' s Influence on Eating Behavior

Functional magnetic resonance imaging (fMRI) studies on brain responses to food stimuli show that when individuals view food pictures, specific brain regions may be activated, including the orbitofrontal cortex, insula, striatum, and amygdala (Labar et al., 2001; Porubská et al., 2006; Yokum et al., 2012). The mechanism of emotion' s influence on eating behavior is similar to that of addiction: for most people, delicious food can increase eating desire, which is essentially sensory reward from tasty food stimuli, and emotion can regulate individuals' appetite to influence subsequent eating behavior. The orbitofrontal cortex and striatum are brain regions for food reward. Neuroscience research on animals found that emotional distress increases the sensitivity of their reward systems to physical stimuli (Piazza & Le Moal, 1996). Specifically, negative emotions (such as social defeat) cause glucocorticoid release, which in turn makes the brain' s reward system sensitive to food and drugs, increasing responses to appetitive stimuli (Adam & Epel, 2007). fMRI scans of chronic dieters viewing food pictures under emotion induction also verified that negative emotions increase the reward system' s sensitivity to food, manifested as activation of the orbitofrontal cortex and striatum (Dylan et al., 2012).

Changes in the food reward system' s appetite under emotional influence are reflected through the insula. Research shows that the insula is highly sensitive to individuals' appetite states (Del Parigi, 2002), and its primary function is monitoring interoceptive cues and internal bodily states (Critchley et al., 2004). Killgore et al. (2006) recruited 13 normal-weight women for fMRI scans while viewing high-calorie and low-calorie food pictures, followed by self-rated emotional states using scales. Results found that participants showed different activation patterns in the orbitofrontal cortex and insula when viewing different calorie foods under different emotional states. This may indicate that a neural mechanism exists between emotional state and food choice tendency, involving the insula and orbitofrontal cortex. According to individuals' emotional

states, they seem to have different responses to different calorie foods. Research on emotional eating found that responses to high-calorie and low-calorie foods were positively related to the insula and dorsolateral prefrontal cortex, and emotional eating was positively correlated with dorsolateral prefrontal cortex activation when choosing or avoiding high-calorie foods (Wood et al., 2016). Additionally, the amygdala plays a crucial role in emotion' s influence on eating behavior. Research has proven that the amygdala functions in encoding both positive and negative emotions (Hamann & Mao, 2002), and its basolateral branch connects bilaterally with the hippocampus, ventromedial prefrontal cortex, and orbitofrontal cortex. These connections seem to maintain habitual behavior, cognitive control, and reward processes respectively (Janak & Tye, 2015). Thus, the neural mechanism of emotion' s influence on eating behavior includes the coordinated action of the amygdala, insula, orbitofrontal cortex, striatum, and ventromedial prefrontal cortex. Existing research on emotion and eating behavior has emphasized the importance of interactions between the amygdala and ventromedial prefrontal cortex (Clithero & Rangel, 2013; Seo et al., 2016).

While the reward mechanism of emotion' s influence on eating behavior is relatively clear, this mechanism only explains subsequent eating tendencies from the perspective of emotion influencing individuals' attitudes toward food (by increasing sensitivity to food through the reward system), overlooking how emotion changes individuals' own inhibitory control abilities. The former approaches from the food perspective, while the latter determines eating behavior characteristics from the self perspective. Inhibitory control enables individuals to control their behavior in service of higher-order goals, and negative emotions weaken inhibitory control abilities, increasing certain impulsive behaviors. One researcher conducted a meta-analysis of 939 relevant studies to assess negative emotions, distress, and cognitive control activation in the anterior cingulate cortex. Results found that all three activated a common region in the anterior cingulate cortex involved in conflict monitoring and inhibition processes, indicating a connection between negative emotions and executing goal-directed behavior (Shackman et al., 2011). Although existing research has proven the relationship between poor eating behavior, inhibitory ability, and negative emotions (Byrne et al., 2020), few studies have explored the underlying neural mechanisms behind these manifestations or considered this mechanism as a theoretical pathway for negative emotions influencing disinhibited eating. Moreover, the neurophysiological mechanisms of eating behavior in eating disorder patients with impaired self-inhibitory control and certain trait populations may be more complex. Clarifying these mechanisms could provide help for future treatment of abnormal eating behavior. Therefore, future research on the neural mechanisms of eating behavior could investigate changes in eating behavior through emotion-influenced inhibitory control abilities.

6. Summary and Outlook

Food is essential for human survival. Eating behavior is regulated not only by metabolic needs (Manning & Batterham, 2014) but also influenced by emotional states, motivation, and self-regulation processes (Treasure et al., 2012). The influence of emotion on individual eating behavior has been extensively studied, providing some understanding of eating behavior manifestations under different emotional states. For a long time, researchers have realized that relying solely on individuals' simple preferences is insufficient to predict their subsequent eating behavior, and the complex relationship between emotion and eating behavior indicates that systematic description of emotion' s influence on eating behavior is necessary.

Based on existing research, certain patterns may exist regarding whether emotion increases or decreases individual eating behavior. Negative emotions tend to lead to unhealthy eating behaviors. In general populations, negative emotions lead individuals to choose high-calorie foods or eat beyond normal ranges (binge eating). In clinical patients, negative emotions may lead to extreme eating behaviors (binge eating or fasting) (Leehr et al., 2018; Lutz et al., 2021; Meule et al., 2019), worsening patients' symptoms, possibly related to their deficits in emotion regulation ability (Aviram-Friedman et al., 2018). From a physiological perspective, negative emotions make people' s brains more sensitive to food reward, making food more tempting and increasing subsequent intake. From a self-control perspective, negative emotions disrupt some people' s long-term goals of maintaining figure through self-monitoring, making them submit to short-term hedonic goals (Seidel et al., 2018). However, negative emotions' influence on eating behavior can also produce different results under some social factors (Le, 2019). Especially among women, sociocultural stereotypes about female figure and behavioral performance may cause women to constrain their behavior more after receiving negative stimuli. For example, traditional culture requires women to maintain elegant postures at all times, and eating too much or not elegantly enough may invite negative evaluation, prompting women to eat more carefully or simply stop eating to maintain self-image. Additionally, individuals with excessive concern about their figure often feel dissatisfied with their bodies, fear gaining weight, and view obesity as extremely terrible. These irrational thoughts may also cause individuals to experience negative emotions and subsequently over-diet. Therefore, future research on eating behavior under negative emotions needs to pay more attention to how these specific factors influence eating characteristics. Discovering some important factors in negative emotion-influenced eating behavior may provide new evidence for this field. Moreover, negative emotions' influence on eating disorder patients' unreasonable eating behaviors is greater than in normal people. Patients' own impaired emotion regulation ability may make them more vulnerable to negative stimuli, leading to difficult-to-alleviate pathological eating behaviors. One study found that after food exposure therapy for anorexia patients, reduced anxiety about food may be related to their own emotion regulation (Young et al., 2020). This

suggests that treatment for eating disorder patients should not only focus on the relationship between symptoms and food but also that interventions focusing on patients' emotion relief and emotion regulation ability may provide new ideas for improving pathological eating behaviors.

Positive emotions' influence on eating behavior may tend toward increased or decreased intake in healthy eating behavior. Two outcomes typically appear: increased food intake or decreased food intake. This inconsistent performance seems related to certain factors and manifests differently in individuals with different traits. A meta-analysis of 56 emotion-eating related studies found that positive emotions promoted eating behavior, which seems to be strong evidence (Evers et al., 2018). However, this study mostly used healthy participants and did not consider populations with high-level goals (such as weight loss and health maintenance) or eating disorders. Although positive emotions break pathological dieting behavior in anorexia patients, for bulimia and binge eating disorder patients who already have excessive eating behavior, increased eating caused by positive emotions obviously causes greater harm. Moreover, existing research has proven that positive emotions can alleviate negative emotions in bulimia and binge eating patients and reduce subsequent calorie consumption (Cardi et al., 2019). Thus, positive emotions' influence on eating behavior can be described separately. In healthy populations, positive emotions seem to induce individuals to view eating as a hedonic short-term goal to increase or maintain this emotional state (Wansink, 2004). However, individuals with goals to maintain health and reject binge eating may become more self-disciplined under positive emotions because positive emotions provide more psychological motivation to resist temptation (Fredrickson, 2001). In eating disorder patients with binge behavior, the role of positive emotions is more definite: First, negative emotions are the main cause of binge eating, and positive emotions, as a strategy to alleviate negative emotions, reduce patients' binge behavior. Second, positive emotions can help patients improve self-regulation ability, making them more motivated to resist negative information and their own bad emotions in life, thereby improving their eating behavior. Third, positive emotions can reduce anorexia patients' vigilance toward food, and patients' own anxiety also alleviates after eating. Therefore, whether reducing or increasing eating behavior, positive emotions seem to play a positive role, with the most obvious effects in eating disorder patients.

Current research results on both positive and negative emotions' influence on eating behavior mostly come from laboratory studies (Cardi, Leppanen et al., 2015). Laboratory studies can strictly control some extraneous factors and provide more accurate causal arguments. However, eating behavior truly exists in people' s daily lives, and emotions mixed into daily eating processes may show different manifestations. Laboratory studies cannot guarantee ecological validity. For example, emotions in experimental research are artificially induced, and participants immediately undergo related food tests. In real life, emotional arousal may be a relatively long process, and people' s mealtimes follow certain patterns, making it impossible to definitively determine the eating behavior re-

sulting from this process. Therefore, in addition to further laboratory research on emotion-influenced eating behavior, adopting more large-sample surveys and more ecologically valid research may provide new evidence for this field. Additionally, in research on emotion' s influence on eating behavior, most stimuli are divided into food vs. non-food or high-calorie vs. low-calorie foods. While this can directly illustrate individuals' attitudes toward food, some foods have special cultural meanings. For example, dumplings, tangyuan, and chocolate are related to traditional festivals in different cultures, and their significance as celebration may be higher than consumption itself. Therefore, culture may also be an important factor in emotion' s influence on eating behavior (Monaco & Bonetto, 2019) and could be incorporated into future research.

In summary, reviewing research on emotion' s influence on eating behavior can not only provide a theoretical foundation for future studies but also, through employing various feasible methods to explore other possible influencing factors in emotion' s effect on eating behavior and providing more ecologically valid explanations, may help formulate reasonable treatment plans for eating disorder patients and provide effective intervention programs for non-clinical populations related to eating behavior (such as those with negative body self-image), preventing the deterioration of unhealthy eating behaviors.

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