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'Liking' and 'wanting' food rewards: Brain substrates and roles in eating disorders

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ABSTRACT

What brain reward systems mediate motivational 'wanting' and hedonic 'liking' for food rewards? And what roles do those systems play in eating disorders? This article surveys recent findings regarding brain mechanisms of hedonic 'liking', such as the existence of cubic-millimeter hedonic hotspots in nucleus accumbens and ventral pallidum for opioid amplification of sensory pleasure. It also considers brain 'wanting' or incentive salience systems important to appetite, such as mesolimbic dopamine systems and opioid motivation circuits that extend beyond the hedonic hotspots. Finally, it considers some potential ways in which 'wanting' and 'liking' might relate to eating disorders.

1. Introduction

Obesity, bulimia, anorexia, and related eating disorders have become more prominent in recent decades, leading to increased concern about how to deal with them. Can improved knowledge about brain reward systems help guide thinking about eating disorders and devising better treatments?

Basic brain systems for food reward carry potential implications for understanding normal eating and eating disorders. It is important to note first that brain reward systems are active participants, not just passive conduits, in the act of eating. The pleasure of sweetness arises within the brain, generated actively by neural systems that paint the pleasure onto the sensation to generate a 'liking' reaction — as a sort of 'pleasure gloss'. We may be used to thinking of sweet tastes as innately pleasant, but their pleasure is not contained in the intrinsic detail of their sensation but rather in their evolved ability to act as keys that unlock activation of brain 'liking' systems [1–3]. This is evident by considering that if the ability to unlock hedonic brain systems is lost, a sweet taste loses its pleasure while remaining sweet as ever. For example, a particular sweet taste can become perceived as disgusting rather than nice when an individual learns a taste aversion for it after pairing with visceral illness [3–6]. Conversely, bitterness activates brain systems of aversion and disgust to be innately aversive, but tastes of cranberries, coffee, beer, gin, or opiates can become pleasant for many individuals when experience makes them into keys for hedonic brain systems.

Understanding brain substrates of pleasure and aversion may open an avenue to understanding the impact of food rewards on eating behavior. Pleasure must be translated into motivation or 'wanting' in order for food reward to influence actual eating behavior, as the motivation to eat involves brain mechanisms of its own.

What brain systems paint a pleasure gloss onto sensation? And what brain systems convert pleasure into a desire to eat? Answers to these questions will be described that have come primarily from animal experiments involving brain and pharmacological manipulation, supported also by human neuroimaging experiments and related studies of eating.

2. Understanding brain reward systems for food 'wanting' versus 'liking'

To find brain mechanisms for 'wanting' and 'liking' first requires that those psychological components of reward be recognizable in measurable ways. This section turns to some issues regarding the brain systems that help generate 'liking' and 'wanting' for food rewards. 'Liking' is essentially a hedonic reaction to the pleasure of a reward. It is nearly what most people mean when they say reward. 'Wanting' on the other hand is not pleasure, even though also a component of reward, and may be less intuitive.

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2.1. What is 'wanting' if it's not 'liking'?

'Wanting' is a shorthand term my colleagues and I use for the psychological process of *incentive salience* [7–10]. Incentive salience is attributed to rewards and their predictive cues, which helps determine their motivational value. Those cues then become potent triggers of 'wanting'. In this way, cravings can be triggered by simply imagining the sight, smell and taste of palatable foods [11].

'Wanting' is psychologically and neurally distinguishable from 'liking', even if they often happen together. According to the incentive salience concept, 'wanting' is a mesolimbic-generated process that can tag certain stimulus representations in the brain that have Pavlovian associations with reward. When incentive salience is attributed to a reward stimulus representation, it makes that stimulus attractive, attention grabbing, and that stimulus and its associated reward suddenly become enhanced motivational targets. Because incentive salience is often triggered by Pavlovian conditioned stimuli or reward cues, it often manifests as cue-triggered 'wanting' for reward. When attributed to a specific stimulus, incentive salience may make an autoshaped cue light appear food-like to the autoshaped pigeon or rat that perceives it, causing the animal to try to eat the cue. In autoshaping, animals sometimes direct behavioral pursuit and consummatory responses towards the Pavlovian cue, literally trying to eat the conditioned stimulus if it is a cue for food reward [12–15]. When attributed to the smell emanating from cooking, incentive salience can rivet a person's attention and trigger sudden thoughts of eating — and perhaps it can do so under some circumstances even if the person merely vividly imagines the delicious food.

But 'wanting' is not 'liking', and both together are necessary for normal reward. 'Wanting' without 'liking' is merely a sham or partial reward, without sensory pleasure in any sense. However, 'wanting' is still an important component of normal reward, especially when combined with 'liking'. Reward in the full sense cannot happen without incentive salience, even if hedonic 'liking' is present. Hedonic 'liking' by itself is simply a triggered affective state—there need be no object of desire or incentive target, and no motivation for further reward. It is the process of incentive salience attribution that makes a specific associated stimulus or action the object of desire, that tags a specific behavior as the rewarded response, and that allows normal pleasure to spur desire for more. 'Liking' and 'wanting' are needed together for full reward. Fortunately, both usually happen together in human life.

2.2. Cognitive goals and ordinary wanting

Before leaving 'wanting' it is useful to note how the incentive salience meaning of the word 'wanting' (with quotation marks) as used above differs from what most people mean by the ordinary sense of the word wanting (without quotation marks). A subjective feeling of desire meant by the ordinary word wanting implies something both cognitive (involving an explicit goal) and conscious (involving a subjective feeling). When you say you want something, you usually have in mind a cognitive expectation or idea of the something-you-want: a declarative representation of your goal. Your representation is based usually on your experience with that thing in the past. Or, if you

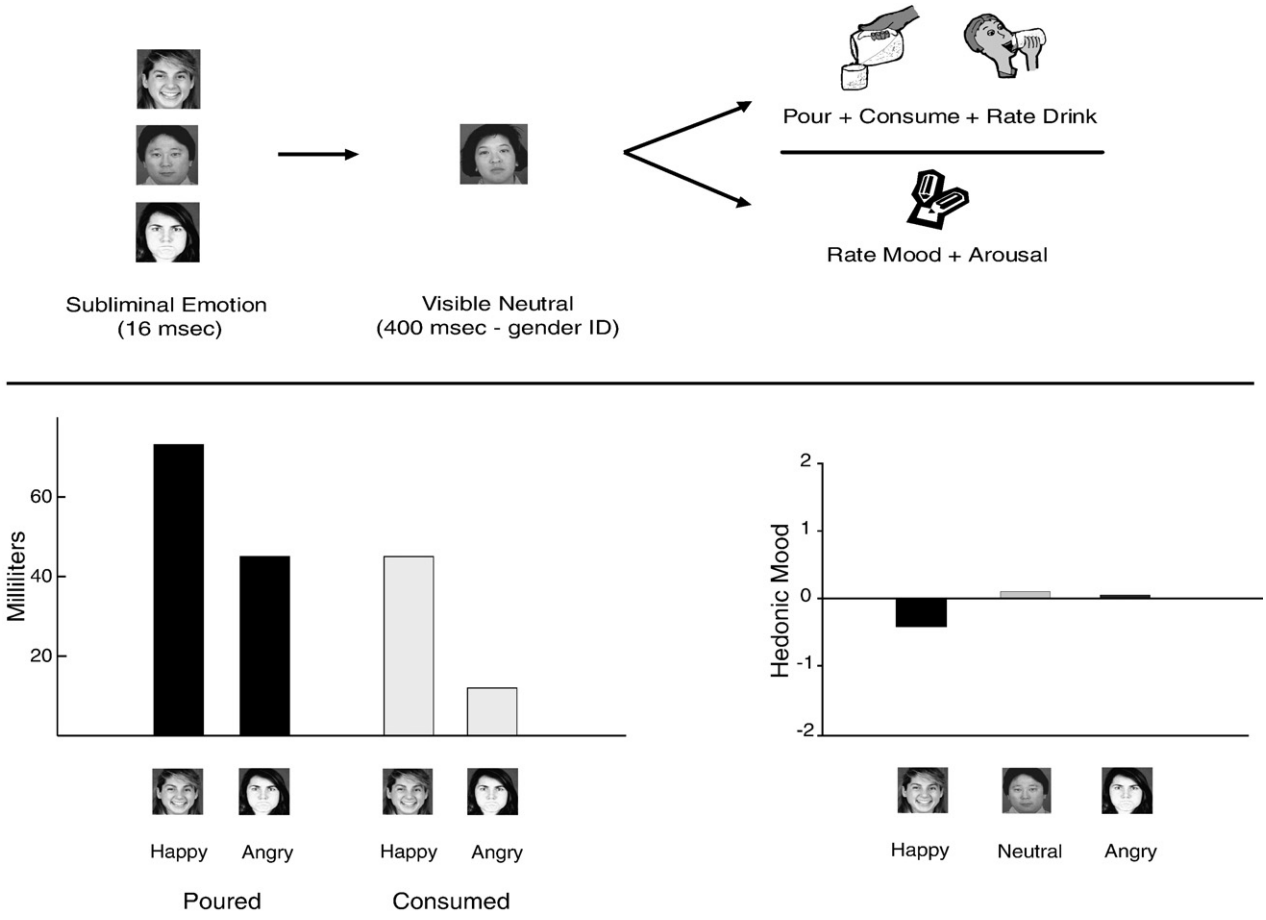

Fig. 1. Unconscious induction of 'liking' and 'wanting' to drink a sweet beverage. Thirsty people were shown subliminally fast visual presentations of either happy facial expressions or angry facial expressions that were too brief to be consciously perceived but should still have activated brain mesolimbic circuits. Then they completed a cognitive task of identifying gender of a consciously seen face (to wipe away any conscious affect engendered by the faces) before being asked to rate their own hedonic mood or to evaluate a sweet citric fruit-flavored beverage, which they could pour and ingest as they wished. No changes in hedonic ratings of subjective mood were detected after subliminal faces, but people poured and drank roughly twice as much after subliminal happy faces than after subliminal angry faces. Modified from [18].