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Chapter 1 : Taste Aversion and Preference Learning in Animals | calendrierdelascience.com

Learning about food: conditioned preferences and aversions. This chapter discusses the motivation, learning, learned aversions, condition preferences, continuum from preference to aversion, social components, position of food cues and palatability in relation to food intake and food selection of poultry, pigs, cattle, sheep and goats.

The pleasure derived from eating and the pleasantness of foods appears to be due to both innate and learned mechanisms. Although a food preference or aversion can develop in numerous ways, most are learned through experience and cultural influences. In addition to cultural influence, there is a substantial amount of individual variation found within cultures. Internal State The pleasure experience of food is extremely dynamic as changes can occur while food is eaten within a single meal. The stimulation to eat generally arises from a combination of internal signals and external stimuli. Generally, when we are hungry we enjoy food more. When a food is approached initially, sensory systems are engaged and arousal is heightened by the visual appearance i. During the consumption of the food, internal mechanisms are operating as the perceived pleasantness of the meal decreases with consumption i. The reported decrease in subjective pleasantness appears to last for at least one hour after eating. This change in pleasantness is adaptive and contributes to normal eating behaviors. There is some evidence that some basic taste preferences may be innate. For example, infants only a few days old can discriminate a sucrose solution from water, showing a distinct preference for the sweet solution. There is also some data indicating human infants show an early aversion to bitter and sour flavours. Although some flavour preferences may be present at or soon after birth, most develop as a result of repeated experience with food i. Conditioned Flavor Aversion A conditioned taste aversion is a highly adaptive phenomenon that develops after a person becomes nauseous or ill after consuming a particular food. Such an aversion has survival value in that it prevents the organism from consuming similar foods in the future. Learned taste aversions are simple, potent, and readily acquired, usually in a single trial. People and animals easily learn to associate certain tastes with positive or negative consequences, whether immediate or delayed. The acquisition of a food aversion generally occurs after only one bad experience. Research shows that aversions are more likely to develop for novel or less preferred foods. Cancer patients undergoing radiation and chemotherapy treatment frequently develop taste aversions for foods consumed near the time of treatment due to the association of the illness symptoms induced by the toxic treatments with the food. Such aversions can have serious consequences, including significant weight loss and malnutrition. Patients are often advised not to eat for several hours before or after treatment to avoid such conditioned aversions. Cultural Influences Humans are exposed to countless numbers of different taste sensations. We are first introduced to different foods by our parents who are guided primarily by their culture. What one culture may enjoy regularly as a staple in their diet may offend and repulse another culture. For example, some cultures in India worship cows whereas most Western cultures consume cows for dietary purposes on a regular basis. The cultural values associated with these animals are evident in the food preferences present in the different cultures. On a less controversial note, specific seasonings, spices, and condiments also have a basic ethnic origin and their use is culturally linked. For example, in Mexico, chili is gradually added to the diet of young children beginning at age 3, and the children observe their family eating it. By age 5 or so, children voluntarily add chili to their own food. This early introduction to chili peppers leads Mexicans to be much more tolerant of spicy foods than most Canadians or Americans. Specific Hungers Food for Thought It is not uncommon for a person to become seriously ill after consuming a great deal of alcohol. However, the nausea and other unpleasant symptoms do not seem to lead to taste aversions for most people. Instead, they merely put a temporary hold on the fun until the next weekend comes around. Specific hungers refers to a genetically programmed taste preference that assists an organism in seeking out foods to meet specific nutritional needs. The idea is that a deficiency of a given nutrient will produce a craving a specific hunger for that nutrient. For example, rats that are deprived of sodium have been found to increase the sodium intake to make up for the deficit. The rats seem to utilize their sense of taste to recognize foods that contain sodium. Unfortunately, the child died after being placed on a standard hospital diet; apparently, the need for sodium reflected in his craving was not satisfied. Contemporary medicine is more likely to diagnose such a condition as a salt-specific hunger and deal with it accordingly.

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Chapter 2 : Food Aversion and Preference Learning in Humans | calendrierdelascience.com

A conditioned taste aversion involves the avoidance of a certain food following a period of illness after consuming that food. These aversions are a great example of how classical conditioning can result in changes in behavior, even after only one incidence of feeling ill.

The English naturalist Charles Darwin was puzzled by an incongruity: Some tender caterpillars were brightly colored and exposed themselves so that they caught the eye of every passing bird. Such behavior appeared maladaptive. Years later, the English anthropologist and naturalist Alfred Russell Wallace suggested that brightly colored butterfly larva probably tasted bitter and might be poisonous; therefore the colors served to deter birds and other predators. Consumption of the colorful insects causes gastric nausea and emesis, and after one or two trials birds and other predators learn to avoid them. As larva, these insects feed on plants that evolved the bitter toxins as a defense against herbivores; the insects turned that defense to their own advantage. Taste aversion learning proved to be widespread in phylogeny and ontogeny. Taste-toxin conditioned aversions have been observed in snails, insects, fish, frogs, salamanders, lizards, snakes, domestic and wild birds, and in mammals, ranging from fetal and neonate rats, to young children and adult humans. Even protozoans reject bitter, the natural taste of plant poisons. The ubiquity of the phenomenon indicates that this mechanism to protect the gut must have evolved many millions of years ago. In the mids taste aversion learning caught the attention of experimental psychologists. They observed that when an animal drinks a tasty solution marked by a bright-noisy signal, and is later injected with a mild toxin, the animal will develop an aversion to the taste but not to the bright-noisy signal. Conversely, if the animal is mildly shocked on the feet, it will avoid the bright-noisy signal but not the tasty solution. Second, and more important, the shock must be applied immediately after the signal for effective learning, but the toxin injection can be delayed for several hours after the consumption of the tasty solution. Moreover, a one trial situation, that is, a single pairing of the taste with the toxin injection, is sufficient to elicit a strong aversion to that particular taste. These factors, known as 1 selective association and 2 long-delay learning, are the major behavioral characteristics of taste aversion learning. This type of behavioral paradigm, that came to be known later as conditioned taste aversion CTA , can tolerate an interstimulus interval of up to six to eight hours between the taste the conditioned stimulus, CS and the malaise inducing agent the unconditioned stimulus, US during the training session. After consumption, the internal representation of the taste would probably be encoded in an "on-hold" position over hours before a decision is being made of whether the food is safe or not. This long interstimulus interval enables the dissociation in time of neuronal events that generate the memory of the sensory stimulus from those that subserve the association of the memory of the CS with the US, that is, the negative reinforcer. Since the s, the ecological paradigm of CTA, by virtue of its aforementioned experimental advantages, has been adopted by several research groups in the study of the behavioral, pharmacological, cellular, and molecular aspects of learning and memory in mammals. In the laboratory, a routine CTA protocol is composed of the following steps: Rejection of the conditioned taste can be easily monitored by measuring the amount of the taste consumed by the animal on the day of the test a single-bottle test , and comparing this volume to that consumed on the day of conditioning. Another way of quantifying aversion to a specific taste is to calculate a so-called "aversion index," based on the total amount of water consumed compared to the taste in a multiple-choice situation. In the rat, the processing of gustatory information begins with transduction of chemical stimuli which reach the oral cavity. The taste receptors send afferents via the facial and glossopharyngeal nerves to the nucleus of the solitary tract in the brainstem. The receptors in the viscera also send vagal fibers converging to the same nucleus. The blood carries absorbed food products to the area postrema, where blood monitors report to the solitari nucleus. Neurophysiological experiments indicate that a complex series of looping circuits interconnect these nuclei in the brainstem with higher brain areas such as the gustatory cortex, located in the insular cortex IC. Although the IC is unnecessary for simple reflex responses to gustatory stimulus, anatomical and metabolic lesion experiments have shown that the IC is required for the retention of learned taste aversion. The amygdala, another region interconnected with the PBN and the IC, is believed to play an important role is assessing the hedonic value of the consumed taste i. All in all, the behavioral, anatomical, and pharmacological data accumulated to date suggest that the IC is the area of the brain involved in the encoding of the memory of the taste and in the processing the detection of taste unfamiliarity see below ; the amygdala as the region responsible for the evaluation of the hedonic value of the taste as well as the expression of CTA; and the PBN as the locus of the CS-US association. An important element in CTA is the novelty, or unfamiliarity, of the taste stimulus. Sampling of any kind of a novel tastant by the rat, even in the absence of the negative reinforcer, will result in the formation of a memory to that specific taste. However, if these same animals are then subjected to CTA training now in the presence of the malaise-inducing compound , they will show a poorer aversion to the taste compared to animals that were not pre-exposed to it. The CS in CTA is most effective in rendering a strong aversion response if it is unfamiliar to the organism at the time of conditioning, A major question is, How does the brain "know" when a taste is familiar or unfamiliar? Taste novelty detection is expected to require some type of fast internal comparator that matches the on-line sensory information with off-line memory information. A potential candidate for this comparator is a corticothalamo-brainstem system. The thalamus may compare the on-line sensory information coming from the brainstem with previous taste memory representations retained in the IC, and when a mismatch is identified if the on-line taste information is novel , it triggers the behavioral response on the one hand, and initiates memory encoding in the IC on the other. By using the advantage of a single conditioning trial, investigators have examined the role of several biochemical and molecular processes involved in the discrete phases of acquisition, consolidation, and extinction of CTA memory. For example, the microinfusion of a protein synthesis inhibitor into the IC blocks CTA learning when administered before the exposure to the taste, but not before the testing trial, indicating that the synthesis of new proteins in the cortex is a critical step for the formation, but not for the retrieval, of the taste memory. Along this line of experimentation, researchers have found that the cellular and molecular mechanisms that subserve CTA are similar to those that subserve other forms of learning. These essential molecular entities are also differentially activated in the brain according to the stimulus dimension and context. For example, muscarinic receptors and activation of members of the mitogen-activated protein kinase MAPK signaling cascade are necessary for the acquisition of CTA to a novel taste but not to a familiar one. As mentioned, CTA results in a robust learning, but yet, this behavior is very plastic. The aversive memory can last for several months without significant decay. However, if after conditioning animals are subsequently exposed to the taste in the absence of the negative reinforcer as in a test situation , and provided that they sample even a tiny amount of the taste, the aversive memory will commence to decay. This phenomenon, first described by the Russian physiologist Ivan Pavlov as experimental extinction, does not result in the erasure of the original aversive memory, but rather reflects a relearning process in which now the new CS-NoUS association comes to control behavior. Memory extinction, learning anew, and learning the new: Dissociations in the molecular machinery of learning in cortex. The role of identified neurotransmitter systems in the response of insular cortex to unfamiliar taste: Activation of ERK and formation of a memory trace. Journal of Neuroscience 20, 7,, Specific and differential activation of mitogen-activated protein kinase cascades by unfamiliar taste in the insular cortex of the behaving rat. Journal of Neuroscience 18, 10,, Memory of a special kind. Paradigms for research in neural mechanisms. Learning with prolonged delay of reinforcement. Psychonomic Science 5, Conditioned aversion to saccharin resulting from exposure to gamma radiation. Their relative effectiveness as a function of the reinforcer. The amygdala in conditioned taste aversion: A functional analysis, 2nd edition. NMDA receptors and the tyrosine phosphorylation of its 2B subunit in taste learning in the rat insular cortex. 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Chapter 3 : Food Preferences & Aversions | Welcome to the University of Calgary

These conditioned preferences persisted for several weeks when the CS+ flavor was no longer paired with IG nutrient infusions. Thus, with the appropriate training procedures, conditioned flavor preferences can be as robust as conditioned flavor aversions.

However, diet selection by humans is unusual in at least two ways. First, most human knowledge about foods comes secondhand, either directly or indirectly from others. Second, the feeding environment of humans living today in the developed world is dramatically different from that in which humans evolved their abilities to choose foods. We experience food excess, rather than food shortage, extraordinary variety in available foods, rather than restricted food choices, and we are exposed to foods with artificially enhanced palatability. Consequently, our evolved mechanisms of food choice, selected for in widely different circumstances, may sometimes prove maladaptive in the modern world. Dietary Specialists and Dietary Generalists Solving the problem of diet selection is relatively simple for animals that eat only one food. Such animals tend to evolve sense organs that identify the chemical signature of whatever species they find edible. For dietary generalistsâ€"animals that, like humans, compose a diet consisting of many different foodsâ€"there is no chemical signature that allows discrimination of food from nonfood items. Dietary generalist have inherent sensory-affective systems biasing them to ingest substances with certain tastes or smells; at birth, human infants like the taste of sugar and reject the bitter of quinine and the sour of lemons. However, dietary generalists still must learn which specific items to ingest and which to avoid eating. Learning to eat nutritious foods while avoiding toxic or worthless potential foods is especially difficult because effects of toxins and nutrients often occur long after their ingestion. Consequently, many animals, humans included, have evolved a special type of conditioning, called taste-aversion learning discussed below as a type of evaluative conditioning , allowing them to bridge the temporal gap between ingesting an item and experiencing consequences of its ingestion. Human Food Rejection and Acceptance Humans reject potential foods for one or more of four reasons. They may find a food distasteful, rejecting it because it has undesirable sensory properties. Alternatively, a food may be rejected because it is perceived as dangerous, for instance, as causing illness such as allergic reaction. A potential food may also be rejected because it is viewed as inappropriate, as, for example, is dirt. Last, some foods may not be eaten because they seem disgusting, as with rotting meat, which is viewed as disgusting by members of some cultures, but not others. There are only two categories of accepted items: Many accepted items have both properties. Effects of Exposure and Conditioning Generally, previous exposure of either humans or other animals to a food without obvious positive or negative consequences "mere" exposure tends to increase liking for that food. On the other hand, a great deal of exposure to a food in a brief period can produce a temporary decline in liking labeled sensory-specific satiety. Too much of even a good thing can produce temporary avoidance of it. A further means of changing response to food preference involves a form of classical conditioning called evaluative conditioning, of which taste-aversion learning is one example. In evaluative conditioning, affective response to a stimulus a conditioned stimulus, or CS is changed as a result of pairing with either a liked or disliked stimulus an unconditioned stimulus, or UCS. In the case of taste-aversion learning, if an animal such as a rat or a human eats a relatively unfamiliar food and, within a few hours, becomes nauseous, the sick individual will develop a distaste for the smell and taste of the food ingestion of which preceded illness. Such taste-aversion learning, reflecting a change in affective response to a food, can seem irrational, occurring even if the sick individual "knows" that the food did not cause the nausea for example, the nausea might clearly be a symptom of the flu. Taste-aversion learning differs from situations in which ingestion of a food is followed by negative effects other than nausea: In the latter case, people can learn that a potential food is dangerous and should not be eaten. However, the taste of the food does not become unpleasant, and the victim of an allergic reaction may continue to want to eat the food causing distress, but will avoid doing so from fear of the consequences. For example, a person who eats shrimp and becomes nauseated tends thereafter to dislike shrimp and may find even the smell of shrimp distasteful, whereas someone who experiences respiratory distress after eating shrimp will avoid eating shrimp but may still like their taste and smell. Nausea serves as a special UCS that, when paired with a food, even once and with a lengthy delay between CS and US, often produces distaste. In humans as in other animals, enhancement of liking for a neutral flavor can occur if it is paired with a desirable flavor, and pairing a neutral flavor with introduction of nutrients into the stomach also can increase liking for the previously neutral flavor. However, pairings of flavors with calories or good tastes usually has modest effects in comparison with pairings of flavors with nausea. Social Influences on Human Food Choices In humans, social forces account for many food preferences and aversions. The process of change could be cognitive, could involve social learning, or could be a form of as-yet unexplored social, classical conditioning. In the last case, displays of pleasure, displeasure, or disgust by another could become associated with a flavor, changing affective response to it. We do know that children show increased liking for foods associated with positive displays by significant others and that such socially induced changes in food preference can last for months. Changes in affective response to foods seem to occur when children do not feel forced or "bribed" to consume a food: However, when the same food is either used as a reward or is seen to be enjoyed by others, it does become liked more. Social factors are almost surely also involved in the development of disgust responses, as when children observe negative responses of their parents to finding half a worm in a half-eaten apple or to body wastes. However, this process has not been investigated. A distinctive feature of the human diet is that many foods that are liked by some humans have sensory properties that are inherently aversive to both other humans and other animals. Members of many cultures like bitter substances such as coffee, quinine water, and tobacco as well as irritants such as chili pepper and horseradish, substances that animals, infant humans, and adults from some other cultures find aversive. Such preferences may be learned in social settings, although we do not really know how. Humans clearly differ from all other animals in the importance of cuisine defined here as a system for selecting, processing, combining, and flavoring foods that incorporates the nutritional wisdom of past generations in their food selection. Although social learning affects food choices of nonhuman animals for example, after an "observer" rat interacts with a "demonstrator" rat that has eaten a food, the observer prefers the food its demonstrator ate , social influences on food choice are neither as pervasive nor as long lasting in nonhuman animals as in humans. Young humans are also probably the only animals explicitly taught what to eat and what to avoid eating, although some evidence suggests that chimpanzees may have rudimentary abilities to instruct their young about foods. Still, only humans learn socially to give foods emotional, social, and moral values, and only humans learn about nutritive values, appropriate times for ingestion, and means of preparation of foods in a manner perhaps best described as social-cognitive, just as they learn about other aspects of the physical environment. Indeed, one of the most surprising facts known about human food choices is that there is little similarity between food preferences of parents and their mature children. Important as teaching, social learning, and cuisine may be in shaping human food choices, other factors, as yet poorly understood, play a major role in shaping the dietary repertoires of humans. Blackie Academic and Professional. Why we eat what we eat: The psychology of eating. Associative learning of likes and dislikes: A review of twenty-five years of research on human evaluative conditioning. Psychological Bulletin , Problems in understanding how we choose foods to eat. Neuroscience and Biobehavioral Reviews 20, Social enhancement of food preferences in Norway rats: The roots of culture, pp. Behavioral regulation of the milieu internal in man and rat. Food choice, acceptance, and consumption. Food is fundamental, fun, frightening, and far reaching. Social Research 66, Neurobiology of food and fluid intake, pp.

Chapter 4 : Evaluative Conditioning and Food Likes and Dislikes

In humans, social forces account for many food preferences and aversions. Approval or disapproval of foods by respected others seems to influence one's own response to those foods, though the way in which such change occurs is not well understood.

This is an open-access article subject to a non-exclusive license between the authors and Frontiers Media SA, which permits use, distribution and reproduction in other forums, provided the original authors and source are credited and other Frontiers conditions are complied with. This article has been cited by other articles in PMC. Abstract Taste is the final arbiter of which chemicals from the environment will be admitted to the body. The action of swallowing a substance leads to a physiological consequence of which the taste system should be informed. Accordingly, taste neurons in the central nervous system are closely allied with those that receive input from the viscera so as to monitor the impact of a recently ingested substance. There is behavioral, anatomical, electrophysiological, gene expression, and neurochemical evidence that the consequences of ingestion influence subsequent food selection through development of either a conditioned taste aversion CTA if illness ensues or a conditioned taste preference CTP if nutrition. This ongoing communication between taste and the viscera permits the animal to tailor its taste system to its individual needs over a lifetime. It is located at the interface of these two vastly different environments, and thus is charged with making the final decision about what, from an uncontrolled and often hostile chemical surround, should be incorporated into the highly controlled biochemical environment within. Taste is the beginning of a long chemosensory tube that extends from palate to intestines, with receptors along that length that are sensitive to the products liberated by digestion. Those on the palate are not unique to taste; the same receptors often occur elsewhere in the body. What is unique is that those serving taste gather their information before the irrevocable decision to swallow has been made, and so can influence that decision. Hence, whereas the distribution of information from other chemical sensors may be limited to the gastrointestinal GI tract, or may be conveyed through the vagus only to the hindbrain, that from taste receptors is projected through the brainstem to the thalamus and multiple cortical sites as well as to ventral forebrain areas. This vast distribution through the central nervous system permits the control of somatic and autonomic reflexes, a cognitive evaluation, and hedonic appreciation. This view of the role of gustation as a visceral internal as well as somatic external sense defines its learning capacity. Taste is exquisitely well suited to learn from visceral consequences satiety, nausea ; it is less inclined to learn from those that are somatic tones, lights, and shocks. As Garcia noted in describing the development of a taste aversion following a meal, no other aspect of the event was implicated in having caused nausea: Taste learning, then, is largely a matter of conditioning. The realm of conditioning can be broadly divided into those events that one can do something about, and those that one cannot. Gustatory learning serves as a special case of classical conditioning, with taste representing the conditioned stimulus CS , and the visceral sequelae of ingestion, the unconditioned stimulus US. Such learning can occur in an appetitive or aversive direction, with the establishment of either conditioned taste aversions CTAs or preferences CTPs. Aversions are more robust. It is of greater urgency to the animal to avoid a chemical that has sickened it than to develop a preference for one among many that have proven to provide nutrition. It is not impaired by placing the animal under deep anesthesia or rendering it comatose before the US is delivered. Indeed, the predisposition of an animal to develop a CTA is so striking that the investigators first suspected it to be an artifact, a suspicion laid to rest only by an exhaustive series of studies and arguments Revusky, As easily as it is created, a CTA is notoriously difficult to extinguish Nolan et al. Having been poisoned is clearly an experience not to be forgotten. With such a dramatic impact on behavior, the CTA has a half-century history as a rich topic of research. Thousands of studies were conducted during the s and s on behavioral variables such as the distinctiveness and novelty of the taste, the nature and severity of the nausea, the amount of time between them and how that time was spent. With these clearly defined, the CTA could be employed by researchers as a tool for altering taste acceptability, creating a profound reduction in acceptance of the CS, from which generalization gradients of both quality and intensity could be determined to reveal the relative similarities among taste qualities. In parallel, behavioral neuroscientists began to investigate the mechanisms by which this extraordinary learning process occurred, using rats in nearly all studies. They performed lesions of taste pathways and relays to determine which areas of the nervous system were required in order to develop and retain a CTA. There followed electrophysiological investigations of the impact of a CTA on taste processing, immunohistochemical studies of gene expression elicited by a CTA, and microdialysis experiments on the neurochemical consequences of the experience. A CTP can be established rather quickly by pairing a novel taste with recovery from a dietary deficiency, most notably the provision of thiamine to animals on a thiamine-deficient diet Rodgers, ; Capretta, More commonly, however, the impact of a CTP on behavior is revealed only gradually over days of continuous pairing of taste with nutrition, though that impact can reach levels equal to those of a CTA in the opposite direction, i. Yet, the CTP may have played a larger role in defining human culture than the CTA, for while the latter is powerful, it is idiosyncratic to the individual. The CTP, by contrast, is often shared by members of a culture where certain foods are available. The gustatory CS comes to be favored by association with the nutritional US, and the cuisine, with all its cultural trappings and traditions, tends to bind its consumers together as part of their cultural identity. In the paragraphs that follow, I will review some of the work on the mechanisms of CTAs and CTPs that have come from our laboratory and those of our colleagues. Investigators have performed lesions of areas that receive such inputs in an effort to define which are crucial to the creation and to subsequent retention of a CTA. Results implicate the area postrema in acquisition Rabin et al. They reveal that loss of the parabrachial nuclei PBN causes the most profound disruption on both creating a CTA with lesions of the lateral division Spector et al. They implicate the ventromedial globus pallidus in both acquisition and retention Hernadi et al. Electrolytic lesions of the basolateral amygdala disrupt the creation and retention of a CTA Yamamoto et al. Lesions of prefrontal cortex have yielded conflicting results, and its role in CTAs remains uncertain. Thus, the cast of participants in creating and retaining a CTA as demonstrated by these fixed, permanent lesions range from the deepest recesses of the brain stem through ventral forebrain to the neocortex. Greater insight may be gleaned from lesions that are reversible, or that combine the loss of more than one area. Ivanova and Bures a , b temporarily disabled regions of the brainstem with microinjections of tetrodotoxin TTX. They reported that TTX injected in the PBN up to one day in advance or four days following training blocked the consolidation of a CTA without affecting the rejection threshold for quinine. Thus, taste processing per se remained intact, but the associative functions required for learning the aversion were disrupted by inactivation of the PBN. The crucial role of PBN in mediating associative taste learning was reinforced by Clark and Bernstein However, when both lesions were made in the same hemisphere, leaving the contralateral hemisphere intact, learning proceeded normally. Electrophysiology The effect of a CTA is to reverse the behavioral reaction to a previously preferred taste to one of the revulsion. The rejection response is organized in caudal brainstem Norgren and Grill, and released in stereotypical fashion upon encountering an inherently aversive stimulus or one to which a CTA has been formed. Here gustatory and visceral afferents converge Norgren, yet do not directly overlap, communicating instead via the adjacent reticular formation, offering a close association between signals from the two necessary components of a CTA. Chang and Scott took single neuron recordings from the NST of rats that were 1 unconditioned tasted the saccharin CS with no subsequent nausea , 2 pseudoconditioned experienced the nausea US with no preceding taste , or 3 conditioned the taste of the saccharin CS was paired with LiCl-induced nausea US. This is reminiscent of the phasic burst of activity elicited by aversive quinine. Moreover, the neural response profile to saccharin in conditioned rats was more similar to those of aversive stimuli. We concluded that the sensory code for the saccharin CS and, to a lesser extent, for other sweet stimuli was altered at the first central taste relay by conditioning, and that such a modification could explain not only the behavioral reaction, but also the immunohistochemical, and neurochemical consequences of a CTA described below. Such a modification of the taste signal might also reveal why the cephalic phase insulin release from the pancreas, a parasympathetic reflex elicited by sweet taste, is blocked after a CTA has been created to that taste Louis-Sylvestre and LeMagnen,

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Chapter 5 : Learning about food: conditioned preferences and aversions.

PSY chapter 6 practice. Explain the role of nausea in acquiring preferences and aversions for food. _____ _____ learning - a conditioned food aversion that.

By Jamie Hale, M. Simply put, this means that our preferences for brands, products, people and other things can be influenced and even modified by the presence of something we like or dislike strongly. Evaluative conditioning has also been associated with the development of food likes and dislikes. Change in food likes has been shown with flavor-flavor pairings: Flavor-flavor conditioning appears to be a potent tool for increasing liking for isolated tastes and specific foods Eertmans et al. Liking for unsweetened vegetables and unfamiliar teas increases after they have been consumed sweetened on a number of occasions Eertmans et al. Willingness to try new foods increases after providing people with verbal information that the foods taste good. It has also been demonstrated that flavor-flavor conditioning can occur through observation Baeyens et al. With observational evaluative conditioning, participants observe a social model being exposed to a CS-US association. The model tastes a food and shows his or her reaction by facial expression or other gestures. Baeyens and colleagues hypothesized that the pairing of a neutral flavor CS with an already liked or disliked flavor US should result in an increase or decrease in liking for the originally neutral flavor. Sugar was used as a positive US, and a bitter tasting substance as a negative US, the flavor of the drink served as the CS. An evaluative conditioning effect was observed in the flavor-flavor, negative condition. However, the evidence for positive flavor-flavor conditioning was weak at best. When children are presented neutral foods as rewards or the foods are paired with attention from adults, the food appears to produce increases in preference Eertmans et al. Evaluative conditioning has been proposed to occur in the presence and absence of awareness Wardle et al. Evaluative conditioning and its relationship with awareness will be addressed in the next article: Stay tuned for part two. Flavor-flavor and color-flavor conditioning in humans. Learning and Motivation, Vol. Learning and Motivation, 29, The Psychology of Eating. Associative Learning of Likes and Dislikes: Behavior, Research and Therapy , 25, Food likes and their relative importance in human eating behavior: Theory and Practice, Vol. The special role of nausea in the acquisition of food dislikes by humans. Flavor evaluative conditioning and contingency awareness. Related Articles Jamie Hale, M. Jamie has written seven books and co-authored one. Retrieved on November 9, , from https:

Chapter 6 : Conditioned taste aversion - Wikipedia

Previous article in issue: A General Theory of Aversion Learning Previous article in issue: A General Theory of Aversion Learning Next article in issue: Contextual Influences on Conditioned Taste Aversions in the Developing Rat Next article in issue: Contextual Influences on Conditioned Taste.

What caused you to get sick? Your illness could have been caused by a touch of the flu, a familiar food that was poorly preserved or prepared, an exposure to a toxin, or a favorite cocktail interacting badly with some medication taken earlier in the day. But even if you are aware of these and other alternative possibilities, there is a high probability that you will blame the novel dish for your illness. Indeed, the taste, and even the thought, of that new menu item may subsequently make your stomach turn, and you may decide never to eat that food again. A person who eats a novel food and then gets ill shortly after, whether or not the food caused the sickness, may become so averse to the food as to never be able to eat it again. Studies exploring how such taste aversions are formed have reshaped theories of learning. Why are we so quick to place the blame for sickness on a novel-tasting food instead of blaming many other equally plausible possibilities? You may be thinking that blaming the unfamiliar food is the most logical response, but why does it seem that way? What makes the connection between a novel taste and illness so strong that it can override these other types of experiences? Answers to these questions, as well as evidence for the reality of the phenomenon itself, were found not in anecdotes but in the results of experiments. Those results shook the foundations of psychology as it existed at the time, and led to a paradigm shift in thinking about how humans and other animals learn in general, and about the conditions under which learning occurs. Our group and others are still exploring the implications of those findings today. Tasty, Bright, and Noisy Water Studies of what would later be termed conditioned taste aversions date back to at least the s. One of the first of these investigations was conducted in support of the British war effort by Charles Elton of the Bureau of Animal Population. In an attempt to develop procedures for the eradication of rats and mice from foxholes and beachheads, Elton and his fellow researchers observed the consequences when rats and mice consumed poisoned baits. In these studies, the rodents would often sample the baits but they would eat only small amounts. This reluctance served to protect the rodents from death, but did not spare them from a rather intense poison-induced illness. After recovering from this toxicosis, the rodents stopped consuming the poisoned baits. This same strategy in the field would have the rats and mice avoiding foods associated with poison, but they would persist by living off other available foods. A classic experiment by John Garcia in the s demonstrated that a rat would associate a taste, but not a light or sound, with illness. In contrast, pain could be associated only with a visual or auditory cue, not a taste. Illustration by barbara Aulicino. In the s, John Garcia demonstrated conditioned taste aversion under quite different laboratory conditions and came to realize that the phenomenon represented much more than a potential means of improving pest control. Early in , Garcia left graduate school at the University of California, Berkeley, and began working at the US Naval Radiological Defense Laboratory at Hunters Point in San Francisco, where he used the rat as a model to study the effects of exposure to radiation on living systems. He noted that rats given water in plastic bottles prior to the induction of radiation sickness subsequently avoided drinking water from those bottles. The same rats would drink the water if it was provided in glass bottles. Garcia and his colleagues speculated that the plastic containers may have given the water a novel taste that the rats associated with the subsequent sickness. Garcia tested this idea by giving rats a novel sweet-tasting saccharin solution during radiation exposure. As expected, when the irradiated rats were tested later, they strongly suppressed intake of the saccharin solution compared to a control group that had not been irradiated after consuming saccharin. The aversion to saccharin persisted for over a month despite the fact that it was acquired after a single pairing of saccharin with radiation. An observation that immediately struck Garcia was that the rats seldom avoided the compartments in which radiation was delivered, and if they did, such avoidance took longer to establish and was less stable than taste aversion. The important implication of this observation was that not all stimuli in this case, external environmental cues versus taste cues were equally associable with radiation sickness. In a landmark test of this hypothesis, Garcia and his colleague Robert Koelling conducted a study in which licking a spout not only delivered a saccharin solution but also activated a flashing light and a clicker. However, the same rats continued to lick the tube when it no longer contained saccharin, but licking still produced the light flash and click. These results showed that sweet taste was much more strongly associated with radiation sickness than were the light and clicker even though pairing with illness was equated for all three types of stimuli. Interestingly, when these same stimuli were paired with electric shock in other groups of rats, only the audiovisual cues, and not the sweet taste, acquired the ability to suppress licking. From these results, Garcia argued for a selectivity of learning in which tastes were preferentially associated with sickness and auditory and visual cues were preferentially associated with shock. That is, learning not only depended on pairing a cue with a consequence, it also depended on which specific types of cues were paired with which specific types of consequences. This conclusion contrasted with the prevailing views, which considered all types of stimuli and consequences to be equally associable. Garcia and his colleagues showed that taste aversions to the sweetener saccharin created after just one session, when animals associated the taste with becoming ill from one of two doses of radiation, persisted for more than two months. Data adapted by Barbara Aulicino from J. Garcia and his colleagues confirmed another atypical characteristic of taste aversion learning when they showed that rats given saccharin to drink followed by drug-induced illness vomiting caused by an injection of apomorphine acquired an aversion to the saccharin solution even when the injection was delayed by as long as 75 minutes after consumption of saccharin. Such long-delay learning also contrasted sharply with the widely held view, based on studies in which auditory or visual cues were paired with food or shock, that little or no learning would occur with delays greater than seconds. Challenges to Learning Theory The findings that strong taste aversions could be acquired after only one pairing of a taste with illness, that tastes compared to other external cues seemed to be selectively associated with illness, and that taste-illness associations could be formed over long delays, violated what others believed to be the laws of learning. Garcia further antagonized the largely behaviorist establishment at the time by arguing that evolution had shaped these characteristics. Specifically, the ability to associate a taste with the effects of poisoning after a single exposure was highly adaptive in that it enabled animals to avoid the potentially fatal consequences of repeated sampling of toxins. Given that illness is often produced by toxic plants or decaying meat, animals that were able to selectively associate tastes with illness were at an evolutionary advantage. And chances of survival were also increased by the ability to bridge temporal gaps between ingestion of foods and the delayed onset of illness that resulted from the slow absorption of toxins during the normal digestive process. Prevailing learning theories made no accommodations for such adaptive specializations. As a result, taste aversion learning and its interpretation were met with skepticism. With so many examples from other domains, taste aversion learning could no longer be viewed as an anomaly. Instead, it became the foundation for the fledgling view that there are biological constraints on learning. This view proposed that although learning itself is a general phenomenon, it could be constrained or facilitated based on the natural history of the animal, and that theories of animal learning and conditioning had to take that natural history into account. Thus, taste aversion learning lost its unique status and was seen instead as one of many different learning phenomena that demonstrated a fundamental role for evolution in behavior. Early Applications Beginning in the middle of the s, principles that had emerged from the earlier studies of taste aversion learning were applied to a variety of other issues. That is, taste aversions were not being studied only to further characterize the phenomenon but also to explore ways in which it could be used to understand and treat a host of other behavioral issues. Such applications have included its use in studying acquired food aversions and preferences during pregnancy, changes in food preferences accompanying cancer development, the biological and neurochemical mediation of learning and memory, the control of attacks on domesticated animals by natural predators, the nature of and control of immunosuppression, and the side effects associated with chemotherapy. The work of Ilene Bernstein and her collaborators at the University of Washington in the late s provides an important example of this latter application. Bernstein noted that children undergoing chemotherapy often acquired aversions to the food they consumed around the time of drug treatment. To substantiate these informal observations, Bernstein gave children a novel food a unique-tasting ice cream immediately prior to receiving chemotherapy and found that they decreased their consumption of the ice cream when they had the opportunity to consume it again, compared to children that received no chemotherapy or that received chemotherapy that was not paired with the ice cream. Twitter This result showed that the pairing of the novel ice cream with chemotherapy was sufficient to condition an aversion and provided an explanation for why children undergoing chemotherapy exhibited changes in food preferences. Importantly, work from other animal models gave insight into ways to reduce or eliminate such aversions and ameliorate this often-reported side effect of chemotherapy. Specifically, novel foods had been reported to have a higher likelihood of being associated with illness than more familiar ones. In other words, when the children ate a novel food such as the ice cream prior to therapy instead of a familiar one, there was an increased likelihood that the novel food, and not foods from their normal diet, would be associated with the illness. Sensing Nutrition The same mechanism of forming a food aversion from pairing a specific taste with gastrointestinal illness turns out to have a parallel positive outcome of forming food preferences, when a taste or flavor is paired with a nutritive or caloric boost in the digestive system. This outcome does not seem very different from the formation of a food aversion produced by pairing oral consumption of a non-nutritive taste with the intraperitoneal injection of a toxin, in that both the preference and the aversion are based on pairing orally consumed stimuli with post-ingestion consequences. Moreover, just as learned food aversions can be seen as performing an adaptive function by protecting animals from ingesting harmful substances, food preference learning can be seen as adaptive by promoting intake of substances that are needed to sustain life. So, we wondered, what would be the consequences of interfering with each of these adaptive functions? A cougar is given meat tainted with a bad-tasting substance. After smelling the bait, the animal performs a disgust response, attempting to bury the meat. Such taste aversion methods have been used to help train predators in the wild not to attack domesticated animals. If one reduced the ability of animals to use the taste of a toxic substance to predict subsequent illness, this result would presumably have adverse consequences for survival by increasing the likelihood of poisoning. Likewise, research we did in collaboration with Susan Swithers and her research group at Purdue University suggests that reducing the ability of tastes to predict caloric outcomes may also produce harmful, but perhaps less immediate, effects on survival. For example, it has often been proposed that based on the normally strong association between sweet taste in the mouth and the arrival of calories in the gut, sweet tastes acquire the capacity to evoke a number of preparatory physiological responses that promote efficient energy use. Given this function, one might expect that experiences that weaken the sweet tasteâ€”calorie association should also interfere with energy and body weight regulation. One way to weaken the adaptive sweet tasteâ€”calorie association would be to consume noncaloric sweeteners, which would involve exposure to sweet taste that is not followed by calories. A variety of experiments with rats have provided support for this hypothesis by showing that exposure to noncaloric sweeteners is followed by increased weight gain and weaker control of the intake of caloric sugars. A review by Swithers shows that similar adverse effects of consuming noncaloric sweeteners have been reported for humans. Thus, both rodent and human data suggest that obesity and its associated problems may be adverse health consequences of weakening the sweet tasteâ€”calorie association. Taste in Intestines The tongue is not the only part of the body with the ability to taste, and hence to play a role in taste aversion. Recent findings establish that basic taste stimuli such as sweet and bitter are detected in the gastrointestinal tract using taste receptors and chemosensory signaling pathways that are much the same as those that are used by the tongue. Andrea Tracy, and later Lindsey Schier, led investigations at Purdue University that provided evidence that gastrointestinal tastes, like orally detected tastes, can be associated with toxicosis, and that those associations could alter ingestive behavior. Taste receptors are not only found on the tongue but also throughout the gastrointestinal tract top. Cell images shown in green are from mice but are analogous to human cells. Taste aversions are formed even when flavors bypass the tongue. When the infusion was laced with a bitter chemical DB , rats quickly learned to stop drinking, whether the infusion contained the nauseating chemical green line or later just saline, NaCl orange line. Illustration adapted by Barbara Aulicino from R. Kinnamon, F Biology Reports 3: Micrographs courtesy of Marco Tizzano. Graph data adapted from L. She then paired one combination of oral flavor and intestinal nutrient infusion such as cherry and fat with illness induced by injections of lithium chloride LiCl , and the other compound such as orange-carbohydrate with saline injections as a control. As expected, intake of the oral flavor paired with LiCl was reduced compared to the flavor paired with saline when those flavors were presented without nutrient infusions. But in addition to this standard conditioned taste aversion, when given the opportunity to consume the gastrointestinal-infused nutrients by mouth without the flavors, Tracy also found what appeared to be an intestinal taste aversion. Apparently, what was learned about nutrients detected solely in the gut modified the ingestive behavior of the rats when they had their first opportunity to orally consume each nutrient. She subsequently showed that rats could learn not only about nutritive intestinal stimuli but also about non-nutritive intestinal flavor cues, if those flavors had been previously infused into the gut in compound with nutritive solutions. Schier extended these findings by establishing intestinal taste aversion learning in studies that assessed rapid, moment-to-moment changes in ingestive behavior. In one experiment, thirsty rats were trained to lick at a sipper spout for a solution of table salt sodium chloride, NaCl. A brief intestinal infusion of either the same salt, or one of the same concentration made with a toxic LiCl solution, was yoked to their licking behavior for the first 6 minutes of each minute session. Because rats were licking for the same NaCl solution at the sipper spout when either NaCl or LiCl was intestinally infused, oral taste cues could not predict the LiCl infusion.

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Chapter 7 : Classical Conditioning â€“ Taste Aversion | Introductory Psychology Blog (S14)_B

- This type of learning allows people to avoid poisonous foods; learning of food preferences and aversions - A conditioned taste aversion is learned if ingestion of a novel flavor is followed by an aversive consequence such as indigestion or food poisoning.

John Garcia noticed that rats developed an aversion to substances consumed prior to being irradiated. To examine this, Garcia put together a study in which three groups of rats were given sweetened water followed by either no radiation, mild radiation, or strong radiation. When rats were subsequently given a choice between sweetened water and regular tap water, rats who had been exposed to radiation drank much less sweetened water than those who had not. This finding ran contrary to much of the learning literature of the time in that the aversion could occur after just a single trial and over a long delay. Garcia proposed that the sweetened water became regarded negatively because of the nausea inducing effects of the radiation, and so began the study of conditioned taste aversion. However, Garcia replicated his results multiple times. He demonstrated that the particular stimulus used in classical conditioning does matter. An internal stimulus produced an internal response while an external stimulus produced an external response; but an external stimulus would not produce an internal response and vice versa. In fact, the subject may hope to enjoy the substance, but the body handles it reflexively. Conditioned taste aversion illustrates the argument that in classical conditioning, a response is elicited. Also, taste aversion generally only requires one trial. The experiments of Ivan Pavlov required several pairings of the neutral stimulus e. With taste aversion, after one association between sickness and a certain food, the food may thereafter elicit the response. In addition, lab experiments generally require very brief less than a second intervals between a neutral stimulus and an unconditioned stimulus. With taste aversion, however, the hotdog a person eats at lunch may be associated with the vomiting that person has in the evening. If the flavor has been encountered before the subject becomes ill, the effect will not be as strong or will not be present. This quality is called latent inhibition. Conditioned taste aversion is often used in laboratories to study gustation and learning in rats. Aversions can also be developed to odors as well as to tastes. Common vampire bats Desmodus rotundus do not learn taste aversions despite being closely related to other species of bats that do. When humans eat bad food e. Also, as in nature, a food does not have to cause the sickness for it to become aversive. A human who eats sushi for the first time and who happens to come down with an unrelated stomach virus may still develop a taste aversion to sushi. Even something as obvious as riding a roller coaster causing nausea after eating the sushi will influence the development of taste aversion to sushi. Humans might also develop aversions to certain types of alcohol because of vomiting during intoxication. Taste aversion is a common problem with chemotherapy patients, who become nauseated because of the drug therapy but associate the nausea with consumption of food. Applications[edit] Taste aversion has been demonstrated in a wide variety of both captive and free-ranging predators. In these studies, animals that consume a bait laced with an undetectable dose of an aversion agent avoid both baits and live prey with the same taste and scent as the baits. When predators detect the aversion agent in the baits, they quickly form aversions to the baits, but discriminate between these and different-tasting live prey. Stimulus generalization[edit] Stimulus generalization is another learning phenomenon that can be illustrated by conditioned taste aversion. This phenomenon demonstrates that we tend to develop aversions even to types of food that resemble the foods which cause us illness. For example, if one eats an orange and gets sick, one might also avoid eating tangerines and clementines because they look similar to oranges, and might lead one to think that they are also dangerous. Stimulus generalization operates in most facets of animal and human life far beyond food tastes and aversion. Trauma and negative reinforcement of all kinds create aversion of other negative reaction to generalizations from the adverse event or events. And like taste aversion, the generalization may or not be conscious. Stimulus generalization is a factor in most "superstitious behavior", racism and prejudice of all kinds. Compared with taste avoidance[edit] Although the terms "taste avoidance" and "taste aversion" are often used interchangeably, studies with rats indicate they are not necessarily synonymous. Taste avoidance and taste aversion can at times go hand in hand, but they cannot be looked at or be defined the same way. Studies on rats to determine how they react to different tasting liquids and injections indicate this difference. Scientists measured the facial and somatic reactions of rats after exposure to a flavored solution sucrose or salt which do not induce abnormal feelings. However, immediately after the rat ingests the solution, the rat is injected with a drug that induces nausea. The rat subsequently expresses a disgust reaction towards the solution, seen by mouth gaping. This is a Pavlovian conditioned response as the rat is associating the disgust with the solution that it drank immediately before the injection. The rat experiences taste aversion. This is similar to when a human, for example, eats a steak that is perfectly safe and edible and coincidentally contracts a stomach bug and starts vomiting within a few hours of eating the steak. Although the human may know that the vomiting was due to a virus and not from eating the steak, the conditioned response in the brain associates the steak with vomiting due to the timing and the human may avoid steak because he has developed a learned taste aversion to the steak. When examining taste avoidance, however, the rat may avoid a food yet still enjoy it and choose it over others. In further tests, the rats were tested with another sucrose solution but this time it was paired with a drug that gave positive, euphoric effects, such as amphetamine , cocaine , and morphine. The rats showed positive reactions to the drugs. However, rats react to any change in physiological state as a sign of danger and avoided approaching these solutions. When one of these euphoric solutions was placed next to another solution that had a learned taste aversion, the rat would choose the substance that it had a taste avoidance towards. Scientists theorize that in terms of evolution, because rats are unable to vomit and immediately purge toxins, rats have developed a strong "first line of defense", which is their sense of taste and smell. This further shows the importance of taste and the correlation between taste and any change in physiological state, whether it be good or bad.

Chapter 8 : Learning through the taste system

taste-aversion learning (Caulliez, Meile, & Nicolaidis,). We investigated the role of the LH in flavor-preference learning induced by the postingestive action of nutrients.

Chapter 9 : Taste, Sickness, and Learning | American Scientist

Conditioned food aversion is a powerful experimental tool to modify animal diets. We have also investigated it as a potential management tool to prevent livestock from grazing poisonous plants such as tall larkspur (Delphinium barbeyi), white locoweed (Oxytropis sericea) and ponderosa pine (Pinus ponderosa) on western US rangelands.