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Pschobiology of Love and It's Implication.

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Abstract

This paper explores the physiological basis of the emotion of love, and how these could be interpreted or linked to overt expressions and behavior. It hypothesizes that the limbic system accumulates emotional energy, is capable of discharging same, and that if it became saturated with positive emotional energy, it would radiate same, thereby giving the bearer an attractive magnetic field (aura), or the opposite state as the case may be. This model holds that positive emotion (interpreted as attractive, charming, or love), and negative emotion (interpreted as repulsive, unattractive, hate, and others) are at two opposite ends of a continuum. Hence, on the emotional scale, there is a mid or neutral point at which the person is neither 'very warm' nor 'very cold'. The involvement of the higher centers of the brain in organizing, interpreting, and channeling of emotional behaviors pointedly shows that even the language of love is processed much the same way languages of other emotions are processed. Indeed love is perceptual, the concept of one person one lover has no physiological support, rather, social norms determine deferential expressions of love and hate, given the level of emotional energy.

Key words: emotion; love; psychobiology; emotional energy.

Introduction

Love is a very complex positive emotion characterized by physiological responses and overt expressions, which together manifest as affectional feelings, attraction and approach or longing behaviours, and attachment that engenders a sense of satisfaction and well being in relation to the loved object, thing or person. It could be said that love is one of the most common words that are not yet fully understood, yet every one has a belief that he/she understands same and could interpret its expressions. It is quite realistic to accept that humans, especially adults in all cultures have the capacity to appreciate and express love in their own ways, as well as perceive when another person is expressing elements of love. It is in this connection that the common expression that love is a universal language becomes a near truism. The fact however remains that expression (overt behaviours) of love is greatly moderated by existing norms and values prevalent in a culture. Indeed, love is language, and like language its expressions and sometimes symbols and connotations differ widely across civilizations, races, and cultures, and even within a big group, many socio-psychological and economic factors seem capable of further moderating its expression. However, psychologists seem to agree that there is a collection of covert and overt responses which could be universally associated with love. It is the concern of this paper to examine the covert components: the physiological basis of this emotion, which is otherwise known as the pycho-biology of love and deduce it's overt implications.

VandesBos (2007), captured the various aspects of love expression when he described love as a complex yet basically integrated emotion involving strong feelings of affection and tenderness for the love object, pleasurable sensations in his or her presence, devotion to his or her well being, and sensitivity to his or her reaction to oneself. According to him, although love takes many forms, including concern for one's fellow humans (brotherly love), parental love, erotic love, self love, and identification with the totality of being (God), the triangular theory of love proposes three essential components: passion, intimacy, and commitment. He observes that social psychological research in this area has focused largely on passionate love, in which passion (sexual desire and excitement) is predominant, and companionate love, in which passion is relatively weak and commitment is strong.

Pesser and Smith (2001) explains that passionate love involves intense emotion, arousal, and yearning for the partners, "we may ride an emotional roller coaster that ranges from ecstasy when the partner is present to heartsickness when the person is absent" pp 398. They view companionate love as involving affection, deep caring about the partner's wellbeing, and a commitment to 'being there' for the other. According to Sprecher and Regan (1998), both types of love contribute to satisfaction in the long-term romantic relationships, while Tucker and Aron (1993) observed that passionate love is less stable and declines more quickly over time than compassionate love, but

this does not mean that the flames of passionate love inevitably extinguish. As mentioned earlier, the triangular theory of love proposed by Sternberg (1988, 1997) has three components of: intimacy that is, closeness, sharing and valuing one's partner, commitment; which is the decision to remain in the relationship, and passion, which is the feelings of romance, physical attraction, and sexual desire. Sternberg further explains that different combinations of these three basic components characterize seven types of love if non love: absence of all three is excluded. Thus, liking is same as intimacy alone, infatuation is passion alone and empty love is commitment alone. The combination of intimacy and passion produce romantic love; the combination of intimacy and commitment produce compassionate love, the combination of passion and commitment produce fatuous love, while consummate love is produced when intimacy, passion and commitment are combined.

The model above largely capture the essence and values of love, that is, even when love could be viewed as a prime quality or value, the model helps to explain the levels and variations of love, and the role behaviours that typify them. It is plausible that people are differentially motivated to engage in the different types of love, that needs or drives are factors that help to explain the kind of love or combination of the components that one is capable of engaging in, or experiencing, learning is indispensably associated with love in all its variations. A common denominator however is that love is an arousal state. These assumptions strongly suggest that many parts of the nervous systems are involved hence neurophysiological component of love is complex. The cognitive arousal model would therefore be the basis for further discourse.

The Cognitive Arousal Model (of Love)

The cognitive arousal theory of emotion is also known as the schachter – singer theory. It proposes that experiencing and identifying emotional states are functions of both physiological arousal and cognitive interpretations of the physical state. It explains that the same state of physiological arousal (eg induced by a measured injection of adrenalin) could be interpreted as fear, anger, or excitement depending on the social context in which an individual was placed, that is, emphasizing the interdependence of physiological, cognitive, and emotional states (VandBos, 2007). According to the cognitive arousal model of love, the passionate component has interacting cognitive and physiological components (Hatfield and Rapson, 1987). Thus, Primed with one's beliefs and expectations about love, if one experiences high arousal in the presence of someone perceived as attractive and desirable, one may feel or believe that he/she is in love or experiencing love. This model explains the phenomenon, of transfer of excitation, in which arousal actually caused by another stimulus or other stimuli is sometimes misinterpreted as love (especially when the 'love object' is co-presented with the stimuli). The possibility of 'conditioning love' in accordance with Pavlovian principles is also strongly suggested by this model. It also forms the pedestal on which the possible relationship between heightened love expressions and 'drug' or 'chemical' states as is often observed with psychotropic substances could be explained.

The Cognitive – Motivational – Relational Theory

This is an extension of the cognitive Appraisal theory that puts equal emphasis on three processes involved in the generation of an emotion: (a) appraisal (the cognitive process) (b) the central role of the individual's striving, intentions, and goals (the motivational process), and (c) the relevance of external events to these strivings (the relational process). In explaining the expression of love, this theory exposes the interaction of biological, learning and situational factors in the arousal and sustenance of love. It strongly suggests that states of physiological arousal, that are not accompanied by enabling environment may not be expressed as love, that necessarily, a state of preparedness underlies the feeling and expression of love when an individual is aroused.

Bio- Chemical Underpinnings of Emotion and Love

Biological and neural mechanisms or contributors to the expression and experience of love could be variously ascribed to the genes, functions of parts of the central nervous system, notably the limbic system and the hypothalamus, the activities of some neuro transmitters and hormones; especially serotonin, dopamine, norepinepherine, and oxytocin.

The genetic and evolutionary explanations are considered together here.

Genetic and Evolutionary Explanation

Possible genetic explanation for experience of love draws impetus from evolutionary biology which holds that species develop genes that enhance survival and natural selection in an ecosystem, and that such genes become

widespread among members of the species over time since those that possess it survive and transmit their qualities to future generations. Thus, evolutionary theory suggests that human capacity to experience love has been evolved as a signal to potential mates that the partner will be a good parent and be likely to help pass genes to future generations (Wikipedia). This theory also implies that love keeps two people together, and this would help raise a child for example, a man and a woman who love each other would be together and work together to raise a child. Back in the tribal days when much of human evolution took place, it would probably require people to successfully raise an offspring, and a mother with a supporting partner would probably have more surviving offspring than a mother in the opposite situation. Thus people with the ability to form love relationships would produce more offspring than those without the ability, and these offspring would have the genes for love, hence the gene for love would become common and that is why most people today have the ability to love (Wikipedia). A polygenic contribution to the foregoing seems most probable considering that no gene for love has been isolated, and that many neurotransmitter substances affect behaviours ascribed to love. Secondly, a primitive part of the limbic system – the hippocampus could have generally developed over generations and its role in modulation of emotion is related to the expression of love. Genetic underpinning could also be inferred from the finding of Tellegen, Lykken, Bouchard, Wilcok, Segal and Rich,1988) that such personality traits as constraint, emotionality, stress reaction, social potency and well-being showed consistency among monozygotic twins even when they were reared apart. These personality traits no doubt have significant implications for intimate interpersonal relationships.

The Limbic System

The limbic system consists of a ring of cortical and sub-cortical structures folded into the inner surface of the temporal lobe surrounding the brain stem and bordering on the corpus callosum. The structures include the amygdale, cingulate gyrus, fornix, hippocampus, parahypoclampalgyrus and septum pellucidum. The limbic system is collectively implicated in basic emotions (including love) hunger, sex and memory. However, it is pertinent that functions of all major structure be properly highlighted.

The Amygdala is an almond-shaped brain structure in the limbic system at the base of the inside of each temporal lobe, contiguous with the olfactory cortex, controlling the experience and expression of emotion (including love), and is involved in motivation, aggression, feeding, and long term memory (through it's links with the hippocampus). Electrical stimulation of this area usually produces an intense emotion of fear.

The cingulated gyrus is another part of the limbic system. It is a gyrus within the longitudinal fissures above, almost surrounding the corpus callosum. It is involved in pain sensation, control of visceral responses associated with emotions, and the planning of motor actions.

The fornix is the long tract of nerve fibres in the brain that forms an arch between the hippocampus and the hypothalamus. It is an efferent pathway of the hippocampus, projecting chiefly to the mammillary bodies.

The hippocampus is a phylogenetically primitive structure in the limbic system of the brain, this sea-horse sloped structure of the forebrain is located in the basal medial region of the temporal lobe (between the thalamus and the main part of the cerebral cortex). It is involved in emotion, motivation, navigation by cognitive maps, learning, and the consolidation of declarative (part of long term) memory.

The parahippocampal gyrus**:** is a ridge (gyrus) on the medial (inner) surface of the temporal lobe of the cerebral cortex, lying over the hippocampus. This component of the limbic system is believed to be involved in spatial or topographic memory. It is also known as the parahippocampal cortex.

The hypothalamus**:** this is the finger shaped area of the diencephalon at the base of the brain in the limbic system, occupying the side walls and floor of the third ventricle, situated below both sides of the thalamus and above the pituitary gland. It consists of two halves with paired right and left nuclei, and is crucially involved in the regulation of the endocrine glands, and the autonomic nervous system, and also implicated in the control of temperature heart rate, blood pressure, hunger, thirst, sexual arousal, predatory aggression, and fight or flight responses.

The Limbic System and Love

The exposition above clearly indicate that limbic system is implicated in all fundamental activities of mammals that engender survival and health through its modulation of various systems of the body, including the endocrine gland, and that it plays a central role in emotional behaviour. It follows that the limbic system is in charge of harmonizing human overt and covert behaviours, and is vulnerable to the influence of internal and external stimuli (cues). Lewis,

Amini, & Lannon (2020), explain three related concepts showing that: human brain chemistry and nervous systems are measurably affected by those closest to them (Limbic resonance); that human systems synchronise with one another in a way that has "profound implications for personality and life long emotional health (limbic regulation); and that these set patterns can be modified through therapeutically practice (limbic revision). They assert that the capacity for empathy and non-verbal connection which is present in animals is a function of the limbic system, and it forms the basis for our social connections as well as the foundation for various models of therapy and healing. They posit that human nervous systems are not self-contained, but rather demonstrably attuned to people around with whom close connection is shared, and explained that within the effulgence of their new brain, mammals developed a capacity they called limbic resonance, which is a symphony of mutual exchange and internal adaptation whereby two mammals become attuned to each other's inner states. Furthermore, "each time we meet another human being and honour their dignity, we help those around us. Their hearts resonate with ours in exactly the same way the strings of an unplucked violin vibrate with the sounds of a violin played nearby. Western psychology has documented this phenomenon of mood contagious or limbic resonance. "If a person filled with panic or hatred walks into a room, we feel it immediately, and unless we are very mindful, that person's negative state will begin to overtake our own, when a joyfully expressive person walks into a room, we can feel that state as well" (Kornfield 2008. P.17).

Limbic resonance and limbic regulation are also referred to as mood contagion or emotional contagion (Barsade, 2002). In a study of group behaviour built on research in social cognition, Barsade found that some emotions, especially positive ones are spread more easily than others through what he called interpersonal limbic regulation. Kaza (2003), sees limbic regulation as a mutual simultaneous exchange of body signals that unfolds between people who are deeply involved with each other, especially parents and children, and correlates love with limbic engagement, asserting that children raised with love learn to remember better than those who are abused. It is plausible that the limbic system's activity explained above could be likened in part to what obtains in the electrical accumulator, which absorbs electrical charges, and is capable of discharging same. Thus, just as the energy in the electrical cell could be harnessed and channeled to produce 'desirable' effects, the higher centres of the brain harnesses the energy stored up in the limbic system (which it draws from the environment) to shape human actions and reaction. It is like a reciprocal or two way traffic process, where the environment provides energy to the limbic system and the limbic system influences the environment. Lewis, Amini, & Lannon (2000), recalls the 13th century experiment of Frederick II in which he deprived infants of human discourse and affection in an attempt to understand language development, and all the infants so deprived eventually died. Also, Brehony (2003), looking at a recent research which shows the importance of proximity of others in human development asserts that "especially in infancy, but throughout our lives, our physical bodies are influencing and being influenced by others with whom we feel a connection; scientists call this limbic regulation" p. 26.

The hypothesis from the foregoing is that from the cradle, the limbic system begins to accumulate both positive and negative 'emotional energy', the rate and quality of which depends on the health of the system and impact from the environments. Such that if the environments are saturated with, or are predominantly charged with positive emotional energy, the limbic system becomes 'positively changed', but 'negatively charged' if the environments are abusive, depriving, unfriendly, or negligent. However, since all environments consist of both positive and negative 'emotional energy', what a person's limbic system becomes charged with eventually depends on the extent to which one charge is able to 'cancel' the other. This of course presupposes that in the event of equal or near equal ups and downs (almost equal positive and negative charges), the limbic system assumes a neutral position or zero charge as each charge 'cancels' the other. This is however not an absolute zero situation but could be likened to the resting potential of the neuron. So that additional energy produces a 'spike potential.' That is, humans build up in the limbic system both positive and negative emotional energy, and what determines which one could radiate 'out' is the one of which the system is saturated. If it is saturated with positive emotions, it radiates same thereby creating a positive magnetic field (aura) around the person. Such a person would posses a calm, attractive and charming personality. If however one's limbic system accumulated and is saturated with negative emotional energy, such a person radiates same, and could be described in such terms as unattractive, repulsive, charmless, anxious, moody or irritable.

Neurochemical Considerations

The foregoing would be better appreciated if the actions of some neuro transmitters are related to the subject matter. Neuroscientists have been studying the involvement of neuro chemicals in the experience of love. Emanuele, Bianchi, Minovetti, Bertona, & Geroldi (2005) found that people in early stage of romantic love had raised plasma

nerve growth factor (NGF) levels. They found that this protein molecule has high levels when people first fall in love, but the NGF returns to previous levels after one year. This empirical study found out that NGF levels were significantly higher in people in love relationship as compared with those in ordinary short and long term relationships. Bancroft (2005), opine that adequate levels of testosterone seem important for both human male and female sexual behaviour. Other neurotransmitters which have been implicated at the attraction state of love relationship include: Dopanine, norepinepherine, and serotorium. However, Slater (2006) holds that which of the neurotransmitters that is triggered in association with passionate love and long term attachment love seem to be particular to the activities in which both persons participate rather than to the nature of the specific people involved.

Serotonin is a common monoamine neurotransmitter in the brain and other parts of the central nervous system, in the gastrointestinal tract, in smooth muscles of the cardiovascular and brachial systems, and in blood platelets. Serotonin has roles in several bio-regulatory processes including mood and emotional processing. VandesBos (2007), holds that levels of serotonin correlate negatively with aggression (therefore, positive for cordiality) and release of serotonin may promote sleep. Sandoni (2001), implicates this neurotransmitter in infatuation, arguing that the serotonin effects of being infatuated have a similar chemical appearance to obsessive – compulsive disorder, and this could explain why people experiencing infatuation cannot think of anyone else.

It has also been hypothesized that since many people who take SSRIs have been observed to loose interest in love, especially romantic relationship, and many do not experience orgasm, then serotonin must have significant influence on the emotion of love. This means that low levels of Serotonin (or rapid reuptake) reduces arousability, and especially the ability to express positive emotions, including love.

The neurotransmitter **Dopamine** is a biogenic amine and catecholamine that is significantly involved in the central nervous system functioning and also functions as a hormone. It has three major pathways within the brain: from the mid brain to the frontal lobes; from the mid brain to the basal ganglia, and from the mid brain to the limbic system. It is the mesolimbic dopamine pathway that is being strongly implicated in experiences of pleasure or reward, as well as responses to salient stimuli in general (Colman, 2003). Dopamine is implicated in emotional expression generally, but it's implication in the experience or interpretation of pleasure and reward, and substance abuse gives impetus to the perception that it is involved in love and attachment. This is because animals (humans inclusive) tend to repeat behaviours that give them pleasure or other forms of benefits. A rewarding 'meeting' may become regular and repeated meetings could produce attachments, especially when the pleasure feeling is on both sides, that is, if both partners feel rewarded by their experiences.

Call to mind the dopamine hypothesis of the aetiology of schizophrenia, and its implication in substance abuse: it is plausible that slightly above 'normal' level of dopamine in the mesolimbic pathway produces an arousal state, which in the presence of love stimuli engenders the overt expressions of passion or lust. Increased level of dopamine may also explain at least partially the expression of obsession with the love object (intimacy and unwillingness to be separated), and why 'lovers' often harm themselves if the love relationship is threatened.

Noradrenalin is a biogenic amine and one of the catecholamine hormones, chemically related to adrenalin, and crucial to the maintenance of alertness, drive, and motivation. It is secreted by the chromatin cells of the adrenal medulla, and most areas of the cerebral cortex. Noradrenalin stimulates the heart muscle to contract, the blood vessels to constrict, the bronchial tracts of the lungs to dilate, and the contractile strength of skeletal muscles to increase. It is important neurotransmitter in the sympathetic nervous system and in the central nervous system mainly through circuits originating in the locus coerucleus of the pons and projecting to many areas of the brain. Significantly low levels of noradrenalin have been implicated in depression and suicide attempts (Colman, 2003).

Depressions and suicide ideation are anti thesis of positive emotions, arousal states and love. Then love necessarily carries heightened arousal, which is associated with 'adequate' levels of noradrenalin. Secondly, as was observed earlier, the hormone stimulates heart muscles, blood vessel constriction, dilation of the bronchi, and increases the contractile strength of skeletal muscles. These physiological effects have been reported in persons expressing love emotion. More importantly, most of these are physiological components necessary for consummation of sex, and almost always accompany orgasm.

Testosterone is the most potent of the androgens (male sex hormones and steroids). It is produced in the testis, although a little amount is produced in the adrenal cortex and the female ovaries, where it is used to synthesize

oestrogen. Testosterone is responsible for the development of male sex organs and secondary sex characteristics. It is also thought to stimulate competiveness and aggression.

The contributions of this hormone to the expression of romantic love seems quite obvious, since without the development of secondary sex characteristics, and sex organs, ability to experience romance is greatly undermined. Again, it engenders the experience of appropriate pre-mating behaviors which has been linked to species survival. Meyers (2007), opine that evolutionary psychology explains the reason why females tend to prefer males of larger frame than themselves, those perceived to be strong, and those who are not docile. These characteristics make men generally attractive to women, and attraction is a prelude to liking and loving experiences. Therefore, testosterone must be significantly linked to the experience and expression of compassionate and passionate love among human males.

Oestrogens are steroid hormones that are produced mainly by the ovaries and act as the principal female sex hormone, inducing estrus in female mammals, and secondary sexual characteristics in female humans. Oestrogens (sing. oestrogen) that occur naturally in humans are oestradiol, oestrone, and oestriol, and they are secreted by the ovarian follicle, corpus luteum, placenta, adrenal cortex, and testis (although in small amounts).

Female secondary sex characteristics which influence the looks of the female from scalp hair to sole of the feet are ineluctably tried to the attractiveness of the female. Besides physical looks, voice is also a part of this characteristics as well as gait. These, together form the criteria for first encounter evaluation of attractiveness to males. Oestrogen is also primarily involved in the menstrual cycle, which prepares the female for procreative activity. All these put together pointedly shows that oestrogen levels prepare the female for passionate and compassionate love.

Oxytocin: This hormone and neurotransmitter (alphahypophane) is secreted by the posterior pituitary (neurohypophysis) in response to direct neural stimulation. It stimulates smooth muscles, particularly in the mammary glands during lactation and the wall of the uterus during labour. In lactating women it is released by the tactile stimuli provided by a nursing infant, and facilitates the expression of milk. In males, oxytocin is implicated in the ejaculatory response during sexual activity.

Oxytocin effect could be implied during fore play when the nipples are stimulated. The direct neural stimulation from the nipple to the hypothalamus gives the pleasure sensation (the reward centre is activated) and this stimulation which the cortex appropriately interprets, triggers other responses that engender the consummation of coital behaviour including salivation and vaginal lubrication.

Processing of Emotional Information

Lahey (2004), holds that in addition to the role played by the cerebral cortex in sensory, motor and cognitive processes, it plays a key role in processing emotional information. The cerebral hemispheres play different roles, such that the right hemisphere plays greater role in both the expression and perception of emotions. The left side of the face which makes stronger expressions of emotions is primarily controlled by the right cerebral hemisphere (Moscovitch & Olds, 1992). That means that the left side of humans' faces smiles and frowns more dramatically. In addition to this ability to govern the expression of emotions, the right hemisphere is also essential for understanding the emotions expressed by others. Beatty (1995) described how patients with right hemisphere damage failed to match emotional tones of voice to pictures of people expressing anger, happiness, indifference and sadness. Patients with left-hemisphere damage, although they had difficulty understanding the meaning of what was said, had no problems identifying the emotions.

The foregoing does not imply that the left hemisphere plays no role in emotions, for as evidenced from the observation that patients who had suffered strokes in the left hemisphere often became depressed while those with right hemisphere stroke were much less depressed, and the findings of Kinsbourne (1988) that many patients with right hemisphere damage are cheerful and not at all depressed by their condition, it follows that the two hemispheres differentially process emotions. According to Lahey (2004), the theory that the left hemisphere plays a greater role in processing positive emotions, whereas the right hemisphere is more involved with negative emotions has been strengthened by findings reported by Richard Davidson of the University of Wisconsin. In that study, several short films were shown to college students – some entertaining films of playful animals, and some "quite gruesome" films of amputations and burn victims. As the students watched the films, there facial expressions were monitored. When they were smiling, the EEG recordings indicated more activity in the left cerebral hemisphere, but when they showed disgust, EEG recordings showed more active right cerebral hemispheres. Heller, Nitscke, & Miller (1988) conclude

that positive emotions are processed more in the left hemisphere, while negative emotions are processed more in the right hemisphere.

Conclusion.

That love is a positive emotion which could be enduring, and that human species over several succeeding generations exhibit this emotion underscores the implications of love in the survival of the species. Like most human activities, emotional behaviour possess both covert and overt components, but unlike many activities that have been better studied and understood, the emotion of love seem to be largely dependent on, or modulated by the neuroglandular systems.

As indicated earlier, no part of the nervous system has been identified as exclusively mediating love, and no 'love gene' has been isolated. However, the centers and neuroglandular chemicals that mediate reward and pleasure have been identified, thereby suggesting strongly that all positive emotions (including love) have the same biological origins and are mediated by the same biochemical apparatus.

This paper had hypothesized that the limbic system accumulates emotional energy, is capable of discharging same, and that if it became saturated with positive emotional energy, it would radiate same, thereby giving the bearer an attractive magnetic field (aura), and vice versa. This model holds that positive versus negative emotions that are interpreted as 'attractive, charming, or love' versus 'repulsive, unattractive, hate, and others' are at two opposite ends of a continuum. Hence, on the emotional scale, there is a mid or neutral point at which the person is neither 'very warm' nor 'very cold'. The involvement of the higher centers of the brain in organizing, interpreting, and channeling emotional behaviours as discussed earlier pointedly shows that even the language of love is processed much the same way other languages of other emotions are processed. Indeed love is perceptual.

In terms of overt behaviour therefore, if one possesses the attractive magnetic field, people would perceive him or her as good and seek to establish close relationship with the person, in the same way this same person would be seeking to establish close relationships with other people who possess the charm. These close relationships thus established become described as liking or love relationships. Thus, loving is not an exclusive behaviour. One person can indeed love many people, just as many people can really love one person. It is our social cognition which is captured properly in the social cognitive theory that sets the boundaries of love relationships.

Aggression, wickedness, ill- mindedness and other non-love behaviors are also not exclusive. Once a person possesses a particular 'emotional energy', the energy is discharged in the presence of an appropriate stimulus and the resultant effect is labeled/interpreted in accordance with existing norms and prevailing language.

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