A Review of Emotions, Behavior and Cognition

Kabir Ali
Iran University of Medical Sciences, Milad Tower، 14535, Iran.
kabirali855@hotmail.com

Correspondence should be addressed to Kabir Ali : kabirali855@hotmail.com.

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Abstract – The American Psychological Association defines "any transient emotional state, typically characterized by moderate intensity." Moods are differentiated from emotions by their non-provocative nature and their potential to emerge spontaneously. Anger can be triggered by various factors; such as insults or even arise without any discernible cause. The complete definition of emotions remains elusive. The investigation of our emotional constitution remains a subject of considerable scholarly interest, as numerous academics propose divergent theories to account for this phenomenon. However, there exists a significant amount of data to analyze when examining the topic. There has been a growing interest within the field of neuroscience regarding the neurological foundations of human emotion, which has been largely driven by advancements in functional neuroimaging techniques. The investigation into the interplay between emotions and other cognitive processes in the brain, such as attention, memory, and reasoning, is gaining increasing significance. The primary focus of this article pertains to the psychological consequences and strategies employed for regulating cognitive processes associated with emotions.

Keywords – Emotions, behavior, cognition, conditioned stimuli, unconditioned stimuli, post-traumatic stress disorder, subjective feeling state

I. INTRODUCTION

Emotions, emotions, and moods are frequently employed synonymously, although they represent discrete psychological states. In accordance with the definition provided by the American Psychological Association (APA), emotion can be described as a multifaceted response pattern that encompasses experiential, behavioral, and physiological components. Emotions encompass the subjective responses individuals experience when encountering stimuli that elicit profound affective states. Each emotional experience consists of three components: the subjective experience, the physiological response of the body, and the subsequent behavioral or expressive manifestation. The study and contemplation of emotional theories have persisted throughout history. The Book of Rights, an ancient Chinese encyclopedia authored during the initial century, references the concept of "primary emotions." The quantification and description of emotions pose challenges due to their inherently subjective nature.

A considerable portion of the scholarly inquiry within the domain of emotional psychology has been directed towards the examination of core emotions, the subsequent psychological and behavioral responses to these emotions, and the consequential implications of emotional intelligence. Typically, individuals unconsciously display and manifest common emotions through facial expressions. Charles Darwin was the initial proponent of the notion that facial expressions conveying emotions are universally observed across various cultures [1]. The central tenet of his theory of evolution posited that emotional manifestations and reactions were inherently biological and, as such, possessed adaptive qualities. It has been widely recognized among scientists that emotions are of significant importance in the survival of nonhuman organisms. It is plausible that our intrinsic emotions have played a pivotal role in facilitating human survival over the course of history, as they provide both ourselves and those in our vicinity with valuable cues for appropriate behavioral responses.

The ability to attribute significance to external events is a characteristic that has been favored through the course of evolutionary mechanisms. Within this particular context, the term "value" pertains to the capacity of an organism to

perceive and respond to the degree of favorability or unfavorability of external events. According to this perspective, emotions are complex internal states that serve as indicators of important external occurrences, either to a certain extent or completely. The breadth of an organism's emotional repertoire is indicative of the complexity of its adaptive niche. The present scenario involves the presence of adaptive requirements within physical, sociocultural, and interpersonal environments, particularly for higher-order primates such as humans. Human attention and memory tend to be selective, prioritizing stimuli that elicit emotional responses such as happiness, sadness, pleasure, or suffering, while disregarding mundane or insignificant information.

Emotions play a pivotal role in shaping human behavior, encompassing both exemplary and detrimental actions, while also serving as a fundamental medium in interpersonal engagements. The impact of emotions on logical reasoning is significant, and it plays a role in the reinforcement of beliefs in manners that have not been comprehensively comprehended or systematically explored. As evidenced by conditions such as obsessive-compulsive disorder (OCD) and schizophrenia, the underlying cause of a majority of human distress and a shared characteristic over the whole assortment of mental illnesses, spanning to psychoses from neuroses, is a disruption in emotional equilibrium. Humans possess a greater range and diversity of emotional experiences compared to other members of the animal kingdom. In this article, a discussion of the growing urgency in the human emotion research domain to develop a neurological understanding of rage, fear, and contempt, is provided.

The field of emotional studies, e.g., [2] reflects larger advancements in the cognitive neurosciences, which have placed significant emphasis on conceptualizing the brain as an information processing system. Olson [3] expressed skepticism regarding the exclusive emphasis on intellectual aspects in the human emotion research. In accordance with James, if we desire to experience a powerful emotion and subsequently attempt to separate our awareness of it from the bodily sensations associated with it, we discover that there is no residual mental substance from which the emotions could be constructed. Consequently, all that remains is a detached and impartial condition of intellectual perceptions. This citation highlights the concept that emotional experiences, being psychological phenomena, possess unique qualities that warrant investigation. To commence, emotions manifest themselves through physical sensations and exhibit discernible and standardized patterns of facial expressions, behavior, and physiological responses, thereby distinguishing them from the majority of other mental states.

According to Li, Qin, and Zhang [3], individuals frequently hold beliefs that are formed prior to and often contradict the deliberate reasoning process we employ to evaluate them. This phenomenon renders emotional states less vulnerable to manipulation by our objectives compared to other psychological states. Finally, it is worth noting that the extensive influence of emotions on our cognitive processes implies that they possess a lesser degree of encapsulation compared to other psychological states. One aspect to consider as substantiation is the increased difficulty in maintaining concentration and the heightened selectivity of our memories when experiencing negative emotions. The subsequent sections delve into the more sophisticated aspects of emotion and their impact on various cognitive processes.

The article proceeds with the subsequent sections: Section II presents a discussion of emotions, perception and attention. In Section III, a discussion of emotions, learning and memory is provided. Section IV reviews the aspect of emotions and subjective feeling states. Section V focusses on emotions and its effects on the process of decision making. Lastly, Section VI draws final remarks to the paper.

II. EMOTION, PERCEPTION, AND ATTENTION

From an evolutionary perspective, it is logical to prioritize the processing of valuable environmental events. One approach to achieve this is through the cultivation of heightened awareness of emotional events, which is facilitated by the activation of emotional arousal in the attentional system. The utilization of conventional visual search and spatial orientation tests provides valuable insights into the impact of emotions on attentional focus. The duration needed to detect a particular target during a visual search frequently increases proportionally with the number of irrelevant distractors, suggesting that serial attentive processing is involved. In the context of emotional stimuli, it has been consistently observed that fear-relevant stimuli elicit heightened attention and are detected with greater speed compared to stimuli depicting neutral or positive emotions, such as individuals displaying happiness, as well as images of spiders or snakes. Targets that are presented on one side as emotional cues, such as spiders, conditioned shapes, spiders and faces, tend to elicit a faster reaction time compared to targets presented on the opposite side of the screen. Neuroimaging datasets employing spatial orientation frameworks have indicated the orbital prefrontal cortex considered as prospective site for interactions.

The human mind, whether in a playful or threatening scenario, has evolved to possess higher cognitive faculties that are built upon a foundation of primary emotional processes. These primary processes serve as pre-programmed execution action frameworks that depend on cognitive appraisal and processing to interpret and evaluate the nature of the situation at hand. Emotions play a crucial role in addressing prototypical adaptive challenges, such as discerning allies from adversaries. They offer a collection of ingrained yet adaptable behavioral patterns, which can be modified through the process of learning and memory. These patterns are evolutionary extensions of the concept of homeostasis and encompass a predictive element that extends beyond the present circumstances, aiming to anticipate future states of homeostatic advantage or danger. This implies that evolution will employ any available mechanisms to guarantee its own perpetuation. The central nervous system (CNS) encompasses various emotional-affective processes, which can be

categorized into three main types. Firstly, primary-process emotions are involved, followed by secondary-process memory and learning. Lastly, tertiary-process high cognitive roles are also significant components.

The influence of fundamental emotional processes, such as classical (Pavlovian) and instrumental (operant) conditioning, on secondary processes is mediated by associative learning mechanisms. These mechanisms give rise to anticipatory emotional behaviors that serve to ensure the survival of individuals. In order to engage in future planning, individuals rely on their prior experiences that are stored in long-term memory (LTM). The learning process subsequently transfers the essential data to high regions of the brain, like the prefrontal cortex, to facilitate higher-order cognitive processes. In essence, the neurodevelopmental progression and establishment of neural connections in the brain illustrate a genetically predetermined inclination to avoid circumstances that elicit feelings of anger, fear, and other negative emotions, with the aim of reducing distressing experiences and enhancing pleasurable forms of stimulation. The acquisition of knowledge is not a subject that can be instructed directly. Instead, all educational endeavors (a secondary process) are constructed upon and rely on preexisting "primary-process emotions" that are influenced by the "Law of Affect". The subsequent sections will delve into the examination of the interconnectedness and functioning of emotional-affective processing sub-levels within the central nervous system (CNS).

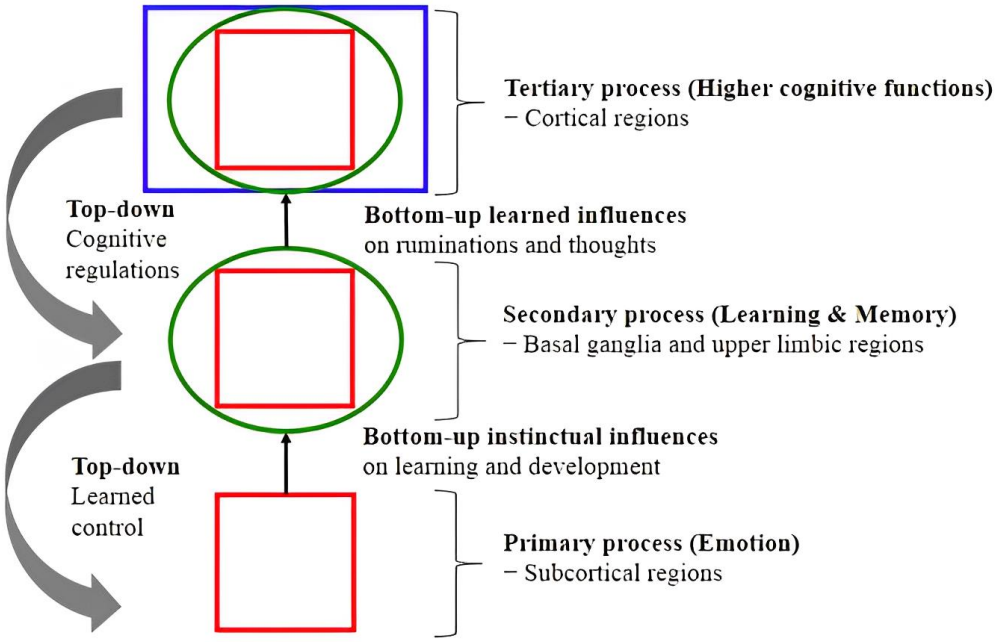

Fig 1. The cyclical hierarchy of "bottom-up" effects and "top-down" restrictions on emotions and cognition

Fig 1 depicts the fundamental interconnections between the primary emotional system processes, which are associated with lower brain function, and the secondary cognitive system processes, which are linked to middle brain function. Additionally, the diagram also represents the tertiary processing, which is associated with upper brain function. The "SEEKING" system, which is driven by innate impulses related to survival and reproduction success, plays a fundamental obligation in primary emotional processing for homeostatic, sensory, and emotional impacts. This process further facilitates memory processing and secondary learning. The regulation of behavior through a top-down approach is facilitated by the cognitive capabilities of the higher brain. These capabilities are developed as secondary processes become increasingly integrated with basic emotional processing. The "Law of Affect," alternatively referred to as the "reinforcement principle," elucidates the role of the brain's emotional networks in governing the process of learning. These networks facilitate essential emotional processing by modulating intricate unconditioned emotional responses, which can be understood as evolutionary "memories." The higher brain capability is contingent upon the coordination of lower brain processes in this bi-circular cause and effect relationship.

Milner, MacLean, and Giesbrecht [5] indicate that there are additional processes involved, beyond the mere "capture of attention," that contribute to the alteration of perception by emotional cues. The term "preattentive" is frequently employed in academic discourse to characterize perceptual processing that takes place in conditions of restricted attention, such as the processing of inputs in disregarded spatial locations. A potential target stimulus for multiple sclerosis (MS) can be concealed within visual backward-masking paradigms through the immediate presentation of a "masking stimulus. "Differential SCRs (skin conductance responses) to fear-essential stimuli contrasted to fear-unessential stimuli, even in the absence of conscious perception of the target stimulus, can be utilized as an indicator of intact processing in scenarios where the concealed target stimulus is an emotionally charged item, such as an angry facial

expression or a spider. The attentional blink paradigm produces comparable findings. The phenomenon of inattentional blindness refers to the diminished awareness of a second target in a visual stream following the detection of the first target. When the secondary objective involves emotionally charged stimuli, there is a notable decrease in the occurrence of inattentional blindness.

Li, Li, and Kou [6] suggest a potential benefit in the recognition of emotional stimuli even when attention is limited. Further support for the differentiation between emotional processing and attentional mechanisms is provided by research conducted on individuals who have experienced specific brain injuries. In instances of damage to the right inferior parietal lobe, individuals may exhibit sensory extinction or spatial neglect, characterized by an inability to perceive stimuli within their contralesional hemifield, despite its presence directly within their visual field. The contralesional deficit is notably diminished when exposed to emotionally arousing stimuli, such as facial expressions of happiness or anger, or images of spiders. The population of individuals with impairment to the primary visual cortex has also exhibited indications of the subconscious processing of emotion. Zheng et al. [7] indicate that there is a phenomenon known as "preattentive processing" of emotional stimuli that happens before the allotment of selective attentions. Pre-attentive processing appears to enhance the ability to detect signals.

The preliminary categorization of emotional stimuli, such as facial expressions, prior to the allocation of attention implies an initial differentiation between emotional and neutral events. MEG has the potential to detect discriminatory responses to emotional faces as prompt as 100-120 milliseconds after the onset of the stimulus. A typical face-based feedback typically begins around 170 ms. At approximately 100 milliseconds (ms), there exists a distinct electroencephalographic potential associated with the intermodal integration of emotion in the presentation of an angry facial expression and accompanying invoice. Intracerebral recordings conducted within the ventral prefrontal cortex have revealed the presence of short-latency responses, occurring within the range of 120 to 160 milliseconds, following the presentation of unpleasant stimuli. Hence, based on electrophysiological evidence, it can be inferred that neural reactions to emotional stimuli are rapid and widespread, manifesting within approximately 170 milliseconds from the onset of the stimulus, preceding responses linked to actual stimulus recognition.

The investigation of how emotional impulses are processed in the brain when attention is directed elsewhere is a captivating subject within the field of neurobiology. A growing body of research suggests that the amygdala has a critical obligation in modulating the impact of emotions on perception. Functional neuroimaging research utilizing visual backward masking systems has demonstrated that an amygdala feedback can effectively differentiate between unseen emotional and non-emotional targets. This response occurs when emotional stimuli are delivered subconsciously.

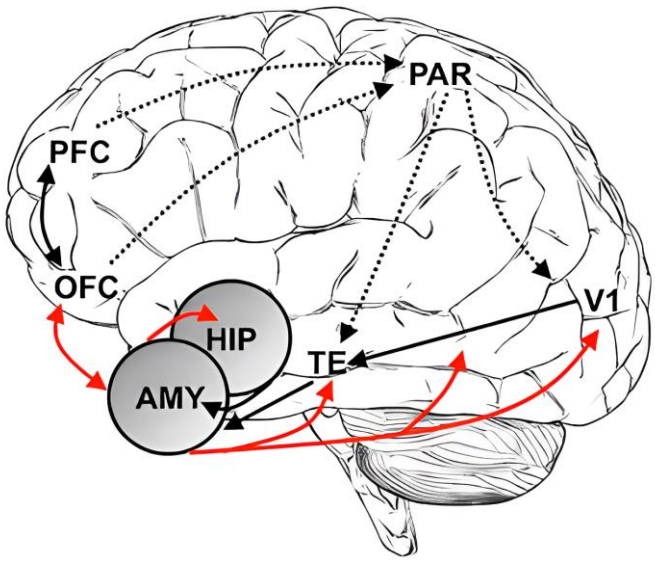

Fig 2. Schematic diagram depicting the brain areas that are involved in specific interactions between cognition and emotion

The amygdala (AMY) establishes bidirectional connections with numerous other regions of the brain. The aforementioned regions encompass the primary visual cortex (V1), the orbitofrontal cortex (OFC), the hippocampus (HIP), and the prefrontal cortex (PFC) (see **Fig 2**). The amygdala is able to receive a substantial amount of sensory data and enhance the neuronal emotional inputs representation due to its connectivity with sensory pathways, attention-related areas such as the prefrontal cortex and memory regions and parietal lobe (PAR). Moreover, the input from the amygdala is transmitted to prefrontal regions involved in higher-level decision-making processes via multiple connections. This enables the modulation of amygdala activity in response to complex motivational situations. Hence, upon activation of the amygdala, it is plausible that other cerebral systems may undergo dynamic reorganization in order to effectively adapt to the prevailing context.

The amygdala's response to frightening faces remains unaffected by the concurrent focus of attention in other trials involving explicit stimulus performance, even when responsiveness is deliberately deployed. Sahraie, Trevethan, Macleod, Weiskrantz, and Hunt [8] have demonstrated that individuals who suffer from visual and blindsight extinction exhibition an amygdala feedback to emotional cues that are obtainable subconsciously in the affected hemifield. The activation of a specific neural circuit involving the subcortical retino-collicu-lar-pulvinar pathway, which is known for its involvement in processing emotional stimuli without conscious awareness, has been found to be associated with the development of residual processing capacity for the presentation of such stimuli. The engagement of this certain routes is of a significant interest, as it has also been connected in residual visual processing observed in individuals with legal blindness. There exists a hypothesis suggesting that the noncortical pathway could potentially serve as a mechanism for processing specific types of emotional information, such as the rudimentary visual cues associated with expressions of terror. This would enable rapid and adaptive responses to threatening situations.

The examination of how pre-attentional emotional event processing enhances and influences perception is a pertinent area of study within the field of neuroscience. The amygdala, alongside other regions of the brain integrated in emotional processing, has the potential to impact the functioning of brain regions responsible for primary object perception. The amygdala obtains inputs from the ventral visual routes and subsequently transmits this information along the entire ventral visual pathway. Neuroimaging research has demonstrated that the functional connectivity between the amygdala and extrastriate visual areas is modulated by the environmental context in which information is being processed. The impairment of visual perception of emotional stimuli is no longer present after sustaining damage to the amygdala, indicating that this association has significant psychological implications.

III. EMOTION, LEARNING, AND MEMORY

Furthermore, the privileged visual emotional events processing not only facilitates the indexing of valuable experiences but also enhances their accessibility to other cognitive fields. The domain in which the impact of emotions on cognitive processes is most prominently observed and investigated is memory. Enhanced memory for valuable events when encountering similar situations in the future may lead to more accurate predictions of physiologically important events. Classical conditioning serves as a prominent illustration of this phenomenon, as it engenders a steadfast and universally manifested form of affective memory. The acquisition of anticipatory capacity by a neutral stimulus occurs when it is consistently paired with an emotional stimulus, such as an unpleasant noise in the context of fear training. This particular form of memory holds significance within the realm of behavior as it potentially functions as a linking mechanism between psychological trauma and the development of post-traumatic stress disorder (PTSD) and fear.

Hopkins, Schultz, Hannula, and Helmstetter [9] have demonstrated that amygdala plays a substantial role in the establishment of implicit memories, particularly in the context of fear conditioning. Despite the fact that individuals with amygdala damage retain conscious awareness of the associations between conditioned stimuli (CS) and unconditioned stimuli (UCS), they exhibit an inability to acquire conditioned fear responses. The persistence of fear conditioning has been observed in individuals who have suffered damage to the hippocampus but still have an intact amygdala, even though they are not consciously aware of the specific associations between conditioned stimuli (CS) and unconditioned stimuli (UCS). Functional neuroimaging studies have also provided confirmation of the significance of the amygdala in the process of CS-UCS association learning. However, it is worth noting that these studies indicate that the involvement of the amygdala in this process is limited to specific time periods.

There exists empirical evidence showing that the objective of the amygdala in emotional learning might be of a temporary nature, implying that other cerebral regions could be accountable for manifesting enduring memory effects. The available evidence indicates that the amygdala has a vital role to play in facilitating various forms of associative learning, such as reward and appetite learning, in addition to its well-documented involvement in fear conditioning research. Extensive documentation exists regarding anecdotal accounts of individuals who have exhibited heightened remembrance for significant occurrences like the Challenger shuttle tragedy and President Kennedy’s assassination [10]. Similarly, there is substantial evidence documenting the experiences of individuals who have demonstrated enhanced autobiographical or explicit memory abilities.

Wang, Huang, Su, and Li [11] have demonstrated that mnemonic enhancement is observed in content that incorporates word-based, picture-based, and personal autobiographical items. This impact is certainly pronouncing in a free recall test, providing further evidence for the influence of emotions in episodic memory functions. Individuals with amnesia, despite experiencing significant difficulties with episodic memory, have demonstrated typical enhancements in memory for emotional information when evaluated through recognition tasks. The central involvement of the amygdala in the formation of emotional memories is a captivating biological phenomenon that transcends the implicit-explicit dichotomy. Consequently, individuals afflicted with bilateral amygdala injury do not exhibit superior performance compared to others in terms of subsequent recollection of distressing experiences and objects. Functional neuroimaging research has provided additional evidence supporting the significant role of the amygdala. This is demonstrated by Hadjikhani and Åsberg Johnels [12] that have shown that the activation of the amygdala during the encoding process is a reliable predictor of the subsequent recollection of emotional content.

Significantly, an essential indicator of long-term recall is the increased activity in the amygdala in reaction to stimuli, whether positive or negative. The amygdala’s involvement in episodic memory surpasses the encoding processes, as

shown by retrieval activities that incorporate emotional objects and situations. Ray, Sullivan, and Henke [13] provide evidence of a modulation of the adrenergic system, indicating a potential neurochemical mechanism through which emotional experiences can enhance memory. The pre-administrations of the pre-adrenoreceptor antagonist propranolol preceding a research study has the potential to inhibit the facilitation of emotional memory in human subjects. There is indirect evidence indicating that the amygdala could potentially serve as a significant site for the actions of propranolol. This inference is drawn from the resemblance observed between the blockade caused by propranolol and the effects observed following injury to the human amygdala.

The amygdala's role in the formation of episodic memory for emotionally arousing information suggests that it serves a purpose beyond transmitting a neuromodulatory signal to other brain structures during the process of encoding. Research in the field of psychology has indicated that the impact of emotion on episodic memory is influenced by the amygdala and the hippocampus. Animal studies of emotion provide detailed accounts of learning-related plastic alterations, including the experience-based sensory cortices return after training. These modifications in neural plasticity may also contribute to the manifestation of emotional memories in individuals. The utilization of neuroimaging techniques has provided evidence indicating the presence of plasticity within the auditory cortex during fear conditioning to auditory stimuli. However, the expression of this plasticity is found to be inhibited when the central muscarinic receptor blocker, scopolamine, is administered prior to the conditioning process. In accordance with previous research conducted on animals, Nazari, Rashidy-Pour, Ali Vafaei, and Raise-Abdullahi [14] indicate that the amygdala is involved in the establishment of enduring memory imprints by influencing cholinergic neurotransmission.

IV. EMOTION AND SUBJECTIVE FEELING STATES

The phenomenon of mixed emotions, which typically entails the simultaneous experience of happiness and grief, has been found to exhibit cultural variation. Scientific research frequently involves the comparison of three distinct types of subjects: Individuals who were born and raised in Eastern societies. There are two distinct groups under consideration: the second group consists of individuals who were born in the Eastern region but were raised in the Western region, while the third group comprises individuals who are native to the Western region. There appears to be a positive correlation between negative and pleasant emotions in individuals of Eastern ancestry and upbringing, as suggested by Treffers, Klarner, and Huy [15]. Individuals who have been socialized in Western cultures exhibit a tendency to perceive a negative correlation between emotions of happiness and sadness, suggesting a greater propensity to experience feelings of sadness as opposed to happiness. Lastly, individuals of East Asian descent who were born in Western countries demonstrate a similar pattern to individuals from Western backgrounds. However, it is worth noting that the inverse correlation between positive and negative emotions is less pronounced in this particular group. Hence, it is logical to posit that individuals who are born in Asia but raised in Western societies possess an emotional constitution that falls somewhere on a spectrum between that of East Asians and Westerners.

In Western linear civilizations, there is a perceived adverse connection between positive and negative emotions. Consequently, individuals from Western cultures hold the belief that the experience of negative emotions and positive emotions is mutually exclusive. However, individuals hailing from dialectical cultures, such as those found in East Asia, perceive a positive association between negative emotions and positive sentiments. One possible explanation for this phenomenon is that individuals from East Asian cultures possess a heightened sensitivity to both positive and negative aspects of a given situation, thereby enhancing their ability to perceive and discern emotions in others. Consequently, individuals of East Asian descent frequently express a variety of emotional experiences.

Baixauli [16] have indicated that within collectivist societies, there exists a diminished association between negative emotions and happiness when compared to individualistic societies. There is a potential for individuals residing in collectivist societies to exhibit a reduced sense of threat in response to sadness, perceiving it as a separate emotional experience distinct from their overall state of pleasure. One plausible hypothesis for this observed cultural distinction is that individuals from the United States may have a comparatively lower level of familiarity with the experience of ambivalent emotions. This phenomenon increases the probability of individuals transitioning rapidly from a state of ambivalence to either a more negative or more positive emotional state. Conversely, as previously mentioned, it is conceivable that Americans may perceive the emotional occurrence in either a positive or negative manner.

There is evidence indicating that individuals from different cultures experience specific emotions, in addition to the observed differences in reported mixed emotions. Emotions such as pride and fury can be classified as "socially disengaged emotions," as they are elicited by experiences that directly affect the individual. Emotions such as guilt, love, vicarious pride, and humiliation exemplify socially engaged emotions, which are elicited by events that are interconnected with others or our engagements with them.

In **Fig 3**, American participants reported experiencing positive disengaging emotions more intensely compared to positive engaging emotions. The study revealed that Japanese participants exhibited greater intensity in positive engaging emotions compared to positive disengaging emotions. Although there were no discernible cross-cultural variations in the positive engaging category, it was observed that Americans exhibited a higher level of intensity for positive disengaging emotions compared to their Japanese counterparts. In **Fig 3**, both Japanese and American participants reported a higher frequency of negative disengaging emotions compared to negative engaging emotions. Nevertheless, there was a notable disparity in the level of emotional disengagement and engagement between Americans. The Japanese participants

indicated a decreased intensity in their experience of engaging emotions, whereas the American participants reported heightened levels of disengaging emotions.

The findings of Hutchison, Gerstein, and Kasai [17] reveal a robust cross-cultural pattern: American participants, in comparison to their Japanese counterparts, exhibited heightened intensity in emotions that are closely linked to the self over a period of two weeks. Nevertheless, individuals hailing from various regions worldwide, such as the United States and Japan, have reported a lack of discernible alterations in the intensity of their emotional involvement. Cultural variations in emotional experience can be observed through intra-cultural comparisons. For instance, it has been noted that Americans tend to prioritize engaging emotions, whereas the Japanese tend to prioritize disengaging emotions. The provision of emotional support can be viewed as a form of constraint. It appears that the quality of friendliness is more closely associated with another construct, specifically, a trait of one's personality.

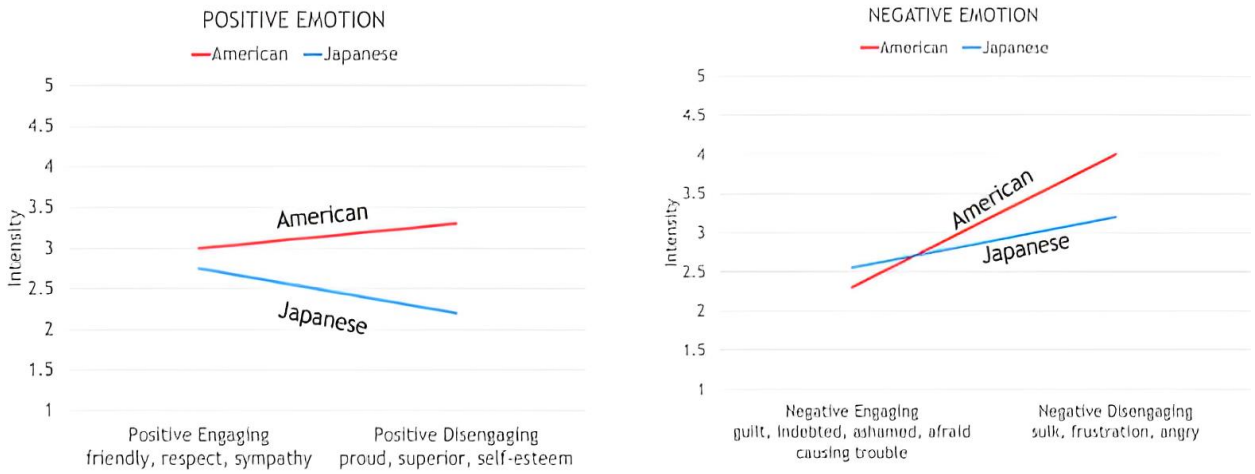

Fig 3. Variations in self-reported positive engaging and positive disengaging emotions between Americans and Japanese individuals (on the left), while differences were observed in negative engaging and negative disengaging emotions (on the right)

Subjective emotions can be categorized as either intense or powerless. Emotions such as pride and superiority are illustrative of potent affective states. When individuals assume personal responsibility and attribute their perceived lack of coping skills, they often encounter feelings of powerlessness. The study conducted by Green, Satyen, and Toumbourou [18] aimed to investigate the potential influence of cultural norms and gender on individuals' emotional experiences. Individuals were selected from a total of 37 distinct countries. Some participants originated from nations with a high Gender Empowerment Measure (GEM), which is a metric used to assess the level of gender equality in a given country. Conversely, other participants hailed from countries with a low GEM. The nation received a commendable GEM score due to the substantial involvement of women in political, economic, and professional spheres, alongside the achievement of gender parity within the workplace.

Countries characterized by a low Gender Empowerment Measure (GEM) score are those in which males hold a higher degree of authority and power in comparison to females. The participants were instructed to recall a specific instance in which they experienced one of six discrete emotions. Subsequently, they were required to rate the intensity of the emotion experienced and determine whether rage or sobbing facial expressions were evident during that particular episode. The prevailing emotions observed were anger and contempt, which were symbolic of consideration of the traditional masculine gender standards. Characteristic of the traditional feminine gender role, individuals often encountered emotions of helplessness, apprehension, despondency, shame, and remorse.

Initially, it is observed that there is a lack of diversity in the intensity of powerful emotions, such as rage or contempt, across different cultures and genders. The main finding of this study indicates that women residing in both low and high Gender Empowerment Measure (GEM) cultures exhibited comparable levels of severity when expressing feelings of helplessness. This suggests that as a society progresses towards greater gender equality, as measured by the Gender Empowerment Measure (GEM), women do not exhibit an inclination towards adopting traditionally masculine characteristics, such as heightened levels of emotional powerlessness. Men residing in nations with lower Gender Empowerment Measure (GEM) scores exhibited a higher degree of helplessness compared to their counterparts in nations with higher GEM scores.

As societies transition from low to high Gender Empowerment Measure (GEM) scores, there is a tendency for males to assume the traditionally masculine role of exhibiting diminished and more vulnerable emotional states. Males residing in nations classified as high Gender Empowerment Measure (GEM) exhibit a reduced prevalence of intense emotional states, such as fear, sorrow, humiliation, and guilt. According to Perray-Redslob and Younes [19], in societies where gender equality decreases, there is a potential for males to experience heightened feelings of helplessness. Why? It is

unlikely that stereotyping plays a significant role in this context. Warfare, corruption, and other adversities such as those mentioned pose significant challenges for individuals residing in nations with low Gender Empowerment Measure (GEM) scores. These challenges have the capacity to induce a sense of helplessness among affected individuals.

The frequency at which individuals exhibit a facial expression indicative of anger is a factor worthy of contemplation. Females exhibited a lower frequency of overt manifestations of anger compared to males in nations with low GEM scores. Nevertheless, in nations with high GEM scores, both males and females indicated experiencing similar instances of encountering an angry facial expression. The findings of this study indicate that as a society progresses towards greater gender equality, women tend to exhibit an increased inclination towards traditionally masculine characteristics, such as the expression of intense emotions. Conversely, men do not exhibit a corresponding increase in traditionally feminine traits. In countries characterized by gender inequality, empirical evidence suggests that males exhibit greater levels of femininity and experience heightened feelings of helplessness.

One challenge associated with human emotion. In studies of emotion, there is a tendency to group together automatic response repertoires, which are commonly known as emotion, and their subjective or experiencing counterparts, which are commonly known as emotions. This is because both concepts are employed to signify the occurrence of an emotional event. The experience of processing stimuli that evoke emotional reactions is accompanied by a sequence of physiological alterations, which are commonly referred to as feelings. The present approach attributes a substantial causal objective to afferent input, encompassing both neurochemical and sensory signals, in the functioning of the brain. It is postulated that this information plays a crucial role in discerning various emotional states. Individuals diagnosed with pure autonomic failure (PAF), a rare condition characterized by the acquired loss of peripheral autonomic control, exhibit a subtle reduction in their ability to perceive emotions. This observation serves as phenomenological evidence supporting the significance of afferent input in the subjective experience of emotion.

While emotions have the ability to subjectively color our experiences, scholarly research indicates that they also exert a significant impact by influencing cognitive and social processes. The necessity for structural organization arises as a consequence of emotional dissection. In contrast to the enduring and regulatory effects on behavior that are facilitated by emotional states, the emotional responses to emotional occurrences are rapid, involuntary, and standardized. If this overarching hypothesis is valid, then it can be inferred that the neural systems involved in the cognitive processing and behavioral response to emotions are distinct from those involved in the subjective experience of emotions. There exists a hypothesis suggesting that the brain stem tegmentum, hypothalamus, insula, as well as the somatosensory and cingulate cortices, play a role in the regulation of emotional states by processing information pertaining to the internal environment, the viscera, and the musculoskeletal system.

An increasing body of evidence suggests that distinct neural networks are involved in the mediation of various emotions and feelings. The findings derived from functional neuroimaging researches [20] showing that the anterior cingulate and insular-somatosensory cortices play a role in the establishment and depiction of peripheral autonomic states. The activation of specific brain regions, such as the hypothalamus, insula, orbitofrontal cortex, and somatosensory cortex, occurs when individuals recall subjective emotional experiences from their past. Individuals diagnosed with PAF exhibit diminished neural activity in regions of the brain that are linked to emotional processing and physical exertion due to their inability to receive visceral afferent signals pertaining to their peripheral bodily state. In these trials, it has been demonstrated that the amygdala, a crucial element in the perception of emotions, exhibits a state of inactivity. According to Swartzwelder [21], it has been observed that individuals with unilateral or bilateral amygdala lesions exhibit intact phenomenal emotional experiences. This finding implies that the neural mechanisms responsible for perceptual-mnemonic and experience effects are not completely isolated within regions of the brain that process emotions.

V. EMOTION AND DECISION-MAKING

Our study revealed the existence of eight primary domains of scientific investigation pertaining to the correlation between emotion and the process of decision making. The aforementioned subsections exhibit considerable variation in the extent of research conducted on them, display limited presence of conflicting theories, provide scarce conclusive findings, showcase a relatively consistent research methodology, and primarily concentrate on fundamental inquiries regarding the essence of emotion and decision making, rather than on further developments pertaining to firmly established phenomena. Nevertheless, the recurrent subsections demonstrate the rapid advancements being made in understanding the psychological foundations of emotions and decision-making. Collectively, these findings provide insight into a unified and overarching inference: emotions exert a significant, foreseeable, and all-encompassing influence on the process of making decisions.

Integral Emotions Impact Decision Making

When conducting a landscape analysis, it is advantageous to possess the ability to classify various emotions. The initial focus is on fundamental emotions, which are emotions that arise from the evaluation or selection under consideration and exert a substantial and consistent influence on the process of decision-making. Individuals who experience apprehension regarding the possibility of making an unfavorable decision may opt to maintain the existing state of affairs instead of embarking on a potentially advantageous course of action. An individual who has previously attended an educational

institution and possesses a profound sense of appreciation towards it may opt to contribute a substantial monetary gift to the establishment, even if it necessitates reducing expenditures in other areas. Emotions of an integral nature exert significant effects on both conscious and unconscious processes.

Integral emotion as significant guideline

Several philosophers have historically championed the notion that emotions can serve as a valuable guide, despite the prevailing pessimistic perspective on the role of emotions in rationality within Western thought. As exemplified by Ehrig, Manjaly, Singh, and Sunder [22], it has been argued that the prevailing inclination to prioritize rational thinking over emotional encounters is misguided. Hume posits that reason is inherently subservient to emotions, with its sole purpose being to dutifully serve and comply with them. From this standpoint, the experience of anger and the apprehension of potential remorse serve as driving forces that prompt individuals to engage in proactive measures upon witnessing instances of injustice. The theory is strongly supported by scientific evidence from individuals who have experienced damage to the vmPFC (ventromedial prefrontal cortex), an acute brain region involved in the integration of emotion and cognition.

According to the research conducted by Sebayang, Gofir, and Asmedi [23], individuals with neurological abnormalities exhibited reduced emotional sensitivity and decision-making efficiency. These impairments cannot be solely attributed to cognitive alterations. Despite being cognizant of the suboptimal nature of their choices, individuals afflicted with injuries to the ventromedial prefrontal cortex (vmPFC) consistently exhibit a preference for riskier financial alternatives over safer options. This inclination persists to such an extent that it can lead to financial ruin in real-money gaming scenarios. The findings from galvanic skin response measurements suggest that the observed behavior can be attributed to a lack of perception of emotional cues, also known as somatic markers, which typically prompt prudent decision-makers to exercise caution when faced with the possibility of undertaking excessive risks.

Integral emotion as bias

The presence of integral emotions can exert an impact on decision-making processes, even in cases where they are not directly linked to the specific choice being considered. An individual's fear of flying can result in their preference for driving as a mode of transportation, even though statistical data indicates that the risk of mortality per mile driven is significantly higher compared to that of flying. Despite being presented with logical arguments supporting an alternative course of action, individuals frequently succumb to their instinctive responses, as evidenced by Arlitt [24] in 1996. When individuals become emotionally attached to potential outcomes, it can become challenging to separate their core feelings from these outcomes. Liu, Holland, Blechert, Quandt, and Veling [25] have demonstrated that robust emotional stimuli, particularly those that are visually salient, can override decisions based on logical reasoning.

Incidental Emotions Impact Decision Making

The concept of carryover of incidental emotion pertains to the phenomenon wherein emotions can endure across different situations and impact actions that are seemingly unrelated to the initial emotional experience. Khan, Coopamootoo, and Ng [26] discovered that individuals tend to attribute incidental anger to others, even when those individuals are not responsible for the initial provocation. Moreover, inadvertent emotions have a tendency to persist even in the absence of conscious awareness.

Incidental emotion as bias

Psychological frameworks have started to explicate both the approaches underlying the occurrence of the carryover influence and the factors that serve to either amplify or diminish its impact. The initial inquiries into the phenomenon of carryover, whether deliberate or inadvertent, exhibited a tendency to classify emotions based on their valence. This approach operated under the assumption that the impacts of positive and negative emotions were indistinguishable. Theories on mood-based cognition propose that individuals tend to make more optimistic assessments when they are in a positive state of mind, while those in a negative state of mind are more likely to make more pessimistic assessments. Cecchi et al. [27] conducted the initial empirical investigation on the influence of incidental mood on risk perception, employing a strategy based on valence.

The methodologies utilized in this influential study subsequently became widely employed in numerous subsequent investigations to assess the effects of transient emotions. The participants were instructed to peruse news articles that were either characterized by a positive tone or a negative tone prior to making estimations regarding the prevalence of certain diseases, such as heart disease, in causing fatalities. When prompted to provide estimations regarding mortality rates, individuals who were exposed to negative narratives exhibited a greater inclination towards pessimism in comparison to those who were exposed to positive narratives. There was no observed correlation between the emotional tone of the narratives and the subsequent evaluations' quality. Conversely, it was the collective psychological state that exerted an impact on assessments.

In the aforementioned year, a subsequent series of influential investigations conducted by Vaqué-Crusellas, González-Carrasco, and Casas [28] revealed that individuals' subjective well-being can be influenced by their perceptions of the immediate environment. This facilitated the exploration of interdisciplinary inquiries into the correlations between

environmental factors and individual's subjective well-being. For instance, scholars in the field of economics have identified a positive connotation between the level of sunlight experienced on a particular day and the performance of stock markets in 26 different countries. This observation builds upon the earlier research conducted by Kämpfer and Mutz [29], which revealed that individuals tend to experience higher levels of happiness and satisfaction during sunny weather conditions. According to a study conducted by Al-Alawi, Al Shaqsi, Tarhini, and Al-Busaidi [30], it was observed that subsequent to the elimination of a national soccer team from the World Cup, shareholders opted to divest their holdings. With the emergence of various promising techniques for assessing public mood and emotion, including evaluating individual subjective experiences as time goes and in various contexts, it is imperative to enhance the refinement of these studies in order to establish stronger connections between micro- and macro-level phenomena.

Moderating factors

The identification of moderating variables for incidental emotional sequelae is currently underway. The affect infusion model proposed by Jeong, Kwon, and Baeck [31] is considered valuable due to its ability to elucidate the settings under which affect, whether it is incidental or integral, affects social judgment. Based on the model's predictions, the infusion of affect into decisions exhibits variation across a processing range. Notably, in situations characterized by novelty or complexity, emotion possesses the highest capacity to influence decision-making. Another noteworthy area of research regarding moderating variables focuses on the hypothesis that individuals with elevated emotional intelligence possess enhanced abilities to identify specific stimuli that elicit their emotions, thereby enabling them to effectively manage and disregard any undesirable accompanying feelings.

The impact of unintentional concern on evaluations of risk was mitigated in a particular study through the disclosure of the root cause of participants' distress. Although both of these novel approaches for mapping moderators have demonstrated their effectiveness, there is a need for increased emphasis on moderators to achieve a detailed comprehension of the interaction between affect and cognition in various private and high-stakes public situations where judgments are formed. Future assessments would greatly benefit from conducting studies that explore the relationship between decision-making and emotions in high-stakes environments, like international conferences, federal legislatures, operating theaters, banks, and spy agencies.

VI. CONCLUSIONS

Emotions are cognitive states resulting from neurophysiological alterations, and they are associated with a diverse array of psychological and physiological manifestations, encompassing varying levels of positive and negative affect. Currently, there is a lack of consensus within the scientific community regarding a universally accepted definition. Emotions exhibit a complex interconnection with various facets of an individual, including their temperament, character, or affective state. Over the past two decades, the field of emotion research has experienced significant growth due to the contributions of various disciplines, including computer science, emotional sociology, history, medicine, and psychology. Extensive research has been conducted to investigate the essence of emotions, as numerous individuals have endeavored to comprehend their origins and purposes. Charles Darwin is widely recognized as the pioneering scholar who first engaged in theoretical speculation regarding the evolutionary origins and purpose of emotions. The field of neuroscience of emotion investigates the neural approaches foundational to the processing of emotional stimuli in the brain, employing advanced imaging approaches such as functional magnetic resonance imaging (fMRI), and positron emission tomography (PET).

The mechanistic perspective posits that emotions could be illustrated as a subjective experience, either negative or positive, which is linked to a specific configuration of physiological responses. Emotions are complex phenomena that encompass various dimensions, such as internal subjective experiences, cognitive processes, outward manifestations of emotion, physiological changes, and behavioral responses. In previous scholarly endeavors, several academics have endeavored to attribute a singular element to the complex construct of emotion. For instance, William James has posited a connection between emotion and individual experiences, behaviorists have associated it with instrumental actions, psychophysiologists have correlated it with biological alterations, and so forth. Contemporary academic discourse posits that emotions are comprised of various constituent elements.

Various academic disciplines have formulated distinct systems for categorizing the numerous facets of emotional experience. Emotion is commonly conceptualized as a subjective and conscious phenomenon, primarily characterized by psychophysiological manifestations, biological reactions, and mental conditions within the domains of psychology and philosophy. The field of sociology employs a comparable multi-factorial model to describe the phenomenon of emotion. Many scholars identify several key components that are integral to the subjective experience of emotion, including physiological manifestations, cultural or emotional categorizations (such as anger or surprise), expressive bodily behaviors, and the assessment of both external events and one's immediate environment. A distinction is commonly made by individuals between the cognitive processes encompassing reasoning and decision-making, referred to as "thinking," and the affective experiences associated with emotions such as joy and sadness, referred to as "feeling." The categorization mentioned may not be universally acknowledged within various theories of emotion.

As the recognition of the significance of emotions in human experience and behavior grows, so does the field of neuroscience dedicated to their investigation. The brainstem's autoregulatory systems, along with cortical regions such as the amygdala, insula, somatosensory cortices, cingulate, and orbitofrontal cortices, are believed to be involved in the

modulation of emotion and sensation. Each of these brain regions makes distinct contributions to our emotional perceptions, memories, behaviors, and experiences. The understanding of the relationship between emotion and the two main dimensions of affective experiences, namely mood and motivation, remains limited irrespective of the development in illustrating emotional anatomy functioning. The investigation of this subject holds significant importance in the realm of studying various mental disorders. Individuals diagnosed with mood disorders exhibit deviations in brain regions that are analogous to those involved in the processing of emotions.

However, the precise nature of this relationship remains unclear from a psychological standpoint. The understanding of neurochemical regulatory mechanisms in the regulation of affective states, including emotions, remains limited. Another perplexing issue pertains to the manner in which emotions can potentially compromise otherwise rational cognitive processes, causing individuals to steadfastly adhere to notions and perspectives lacking factual or logical basis. There is a crucial requirement to conduct research on the obligation of emotions in the development of cognition, particularly focusing on the impact of empathy development on the mechanisms underlying the formation of self-awareness and social skills.

Data Availability
No data was used to support this study.

Conflicts of Interests
The author(s) declare(s) that they have no conflicts of interest.

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