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THE ROLE OF THE ENTANGLED BRAIN CONCEPT IN UNRAVELING THE COMPLEXITY OF DECISION MAKING AND COMMUNICATION IN THE METAVERSE

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ABSTRACT

Acquiring a significant understanding of customer behavior, particularly in the decision-making process related to materials in the metaverse, is crucial for developing efficient digital marketing strategies. This study employs the notion of the entangled brain as its primary theoretical foundation. It investigates the influence of the brain's intricate, non-linear, and mutually reinforcing processes on consumer decision-making while also considering determinism, libertarianism, and compatibility. This study suggests that decision outcomes exhibit unpredictability akin to quantum processes by emphasizing the parallels between quantum entanglement and brain activity. Accordingly, this study emphasizes the challenges of predicting human behavior, especially in emerging technologies like the metaverse, where uncertainty can highly occur. Thus, this study offers a theoretical framework combining deterministic and probabilistic perspectives and useful insights about understanding consumer behavior in dynamic digital environments. This study improves our understanding of decision-making processes, emphasizing the significance of adaptable strategies for navigating complex consumer settings.

KEYWORDS *Entangled Brain Concept, Metaverse, Marketing Strategies*

INTRODUCTION

The study of decision making in marketing communication has been going on for a long time (Raupp & Hoffjann, 2012). However, it becomes more challenging as digital technology continues to evolve, including the Metaverse, which blurs the line between virtual reality and offline reality (Dwivedi et al., 2022; Xi et al., 2023). The term Metaverse is not actually something new because it had appeared in Neal Stephenson's 1992 work Snow Crash (Damar, 2021). Metaverse is a new technology that integrates Artificial Intelligence (AI), Augmented Reality (AR), and Virtual Reality (VR) in one integrated digital space (Oliveira et al., 2022).

Companies can use the unique potential of the metaverse to shape innovative social interactions through its novelty in various fields including sales (Dwivedi et

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al., 2022; Hennig-Thurau & Ognibeni, 2022). Referring to the impact of the metaverse on consumers (Konyalioglu, 2023), a study needs to be conducted to find out how consumers interact with the metaverse. Thus, a study of consumer behavior to understand how consumers make decisions needs to be carried out (Putri et al., 2022).

Technological developments bring about change. For example, the emergence of social media has an impact on people's behavior, attitudes, and perceptions, as well as creating dependence (Hidayat et al., 2023; Meilinda et al., 2020). This proves that technology can influence consumers' thoughts and behavior. In addition, changes have also occurred due to the Metaverse, which has had a different impact from previous technologies (Kye et al., 2021). Thus, in order to fully understand these changes, it is necessary to conduct research on consumer behavior so that we can keep up with developments in consumer behavior that have occurred due to the emergence of the metaverse.

In order to understand consumer behavior in more depth, neuroscience can be involved (Kenning & Linzmajer, 2011; Shaw & Bagozzi, 2018). Although external factors such as sales promotions have an impact on consumer decisions, the role of internal factors in consumer decision-making such as human neurobiological mechanisms cannot be denied (Soyomukti, 2015). So neuroscience can be used as a foundation for understanding the dynamics of consumer behavior in interacting with the metaverse. However, before researching neuroscience-based consumer behavior, a tested neuroscience foundation is needed, not an outdated or erroneous neuroscience view. If the foundation is wrong, it will have an impact on the research findings obtained. This needs to be done considering that there are still many who are mistaken or lack of knowledge in neuroscience studies. For example, many still think that artists are right-brain dominant and scientists are left-brain dominant (Corballis, 2014; Wahyuningsih & Sunni, 2020). In fact, research has long proven that problematic left brain also impacts creativity (Gardner, 1982; Hines, 1991).

The left and right brain actually work simultaneously (Coch, 2021). Seeing as there is still this misunderstanding, a good neuroscience basis is needed before conducting neuroscience-based consumer behavior research. So the first step is to build a conceptual framework to form the right neuroscience foundation in accordance with the latest research. In this case, a literature study was conducted to build a conceptual framework (Rocco & Plakhotnik, 2009). Thus, the direction of this research is to build a neuroscience conceptual framework based on the latest studies to become the foundation for conducting neuroscience-based consumer behavior research.

RESEARCH METHOD

This study used a systematic review approach. This approach seeks to conduct a thorough literature search by gathering a comprehensive understanding. Systematic reviews are studies that systematically search, appraise, and synthesize research evidence, often following guidelines for conducting a review (Grant & Booth, 2009). This study ensured that only literature relevant to the topic and of high quality was analyzed. The presentation of this research is presented in a narrative manner to summarize important findings and identify gaps in previous

research so that this research can bring academic novelty in the form of concepts and paradigms that can be used to examine the complexity of decision making. The data collection process involved searching several academic databases such as PubMed, Google Scholar, ScienceDirect, and IEEE Xplore. The keywords used in the search included "entangled brain," "metaverse," "consumer behavior," "decision-making," and "neuroscience." Articles were selected based on their relevance to the topic, quality, and adherence to the inclusion criteria set for the study. Articles published within the last 10 years were selected to be relevant to current knowledge.

RESULT AND DISCUSSION

According to Luhn and Hüther (2021) neuroscience and artificial intelligence are based on a determinist perspective that also has a major impact on the overall technological roadmap of Homo sapiens. The argument that explains why determinism is acceptable is that the human brain is predetermined by genetic processes, particularly DNA. Epigenetic processes, such as DNA methylation and histone acetylation contribute to regulating the likelihood of gene expression during brain development (Berardi et al., 2015). This neuroscientific view of determinism states that human preferences that impact decision-making are predetermined without humans realizing it. For example, there are herbivorous and carnivorous animals where they do not consider whether to choose to eat plants or meat. Those tastes are already there in and of themselves. Similarly, many other abilities are predetermined. For example, animals such as insects have a distinctly different way of communicating than humans. Although there is a study that states that insects can count, understand the concepts of equality and inequality, acquire complex skills through observation, and have an awareness of body proportions, related features (Chittka, 2023). However, there is no way and no proof that insects can be trained to speak like humans.

Unlike animals, the human brain has been formed in such a way that it includes the ability to speak with language verbally. This view can also be seen from the computer that just like the human brain, the computer also performs calculation operations including processing, storing, and processing information (Chirimuuta, 2021). If a computer is not equipped with any calculation operations, it will not be possible for the computer to calculate the numbers given by the user. This means that a computer can only perform calculations if it has been previously designed to count. Since computers have similarities with humans, so does the human brain.

The development of artificial neural network technology or artificial intelligence further emphasizes that the brainhuman is like the artificial neural network. This network consists of a number of cells, nodes, or neurons that connect a collection of inputs with outputs where all of them are designed to follow the human brain (Dastres & Soori, 2021). Since computers are similar to the way the human brain works and reinforced by the presence of artificial neural networks that are made to follow the workings of the human brain, then just as computers are formed to operate, so too is the human brain capable of doing things because it has been formed so. The view of determinism is supported by computers and also the

emergence of artificial neural networks where it confirms that the human brain works this way.

This view of determinism is similar to what was conveyed by Immanue Kant in his book entitled kritik der reiner vernunft or Critique of Pure Reason. Immanuel Kant proposed the term a priori, which is something that precedes sensory experience, where this is the principle that makes experience possible (Kant, 1781). Immanuel Kant explained about transcendental philosophy which is an investigation of things that are a priori (Aprioriforschung) where this allows knowledge (Sitorus, 2016). Immanuel Kant's view is a view that is in line with the determinism perspective, which both view the human brain as predetermined by something. Immanuel Kant views that there are 12 a priori categories that become instruments or frameworks to enable the emergence of knowledge (Lanigan, 2019). These categories determine how humans understand reality.

Immanuel Kant was also influenced by the thoughts of Isaac Newton who had a determinist viewpoint in the realm of classical physics (Bird, 2006.). Newton's formulation is that force causes changes in the motion of objects proportional to force and inversely proportional to mass. The formulation reflects Newton's deterministic view of classical physics (Tweney, 1997). Kant's view in his presentation as well as Newton's formulation, and artificial intelligence become justifications for the deterministic view.

The emergence of artificial intelligence is essentially beneficial to create machines that are able to mimic human thought processes and behaviors that include various things such as processing perception, reasoning, learning, planning, prediction, and more. In addition, Artificial intelligence includes the ability to adapt (Tutsoy, 2021). The presence of such technology helps organizations in improving their ability to respond to environmental changes (Dwivedi et al., 2021). This even suggests that artificial intelligence's ability to adapt is evidence of the non-deterministic human brain. But for the proponents of determinism, adaptability is not a refutation of determinism. For them, it is proof that the human brain has been formed or determined to be adaptable from the beginning.

All reactions from the human brain are considered part of the preconceived workings of the brain where this can be argued (Ellis, 2021), For this view, Humans are powerless to make judgments or act in a deterministic system where natural laws and past events govern every aspect of life (Fischborn, 2016). The extent to which they regulate human adaptability is unclear. Therefore, although the determinism framework looks convincing, especially in light of the development of artificial intelligence technology, it cannot accurately measure the extent of human adaptability.

As artificial intelligence technologies, including artificial neural networks, are modeled after the human brain (Huang, 2017), the consequence is that they work the same way as the human brain. Therefore, if these technologies work deterministically, the human brain should work similarly. Conversely, if all these technologies are declared not to work deterministically, then the human brain should not be deterministic either. But for libertarians, universal determinism is incompatible with free choice because it teaches that humans are creatures who are subject to things that are predetermined (Fischborn, 2016). Thus, the determinist

view that the human brain is predetermined is opposed by libertarians. In order to design a conceptual framework that is more relevant and in line with current research, recent research is needed that can be used as a foundation for creating a conceptual framework. The research used is that of the Massachusetts Institute of Technology (MIT) faculty. This institution is ranked number 1 in the world (Faghri & Bergman, 2024). The research has kept up with the latest relevant science, namely the research of Luis Pessoa, a neuroscientist who teaches at MIT. In his study, he stated that the human brain works like quantum mechanics.

Pessoa calls his research the entangled brain and it will be published in book form in 2022 (Pessoa, 2022). In contrast to the deterministic viewpoint that human actions are determined by causes that precede them, entangled brain research states that human decision-making arises from the interaction of various neural circuits, external stimuli and internal states. This means that human behavior is not solely determined by fixed neural pathways, but is shaped by many factors, allowing for choice and free will. This concept states that the complexity of brain dynamics comes from highly interconnected and repetitive circuits (Druckmann & Rust, 2023). The human brain works non-linearly, in contrast to the common understanding that it is linear. For example, the amygdala regulates emotions, behavior, and change through associative learning and the fight or flight response via efferent projections to cortical and subcortical structures (Šimić et al., 2021). The statement is not wrong but the amygdala is actually not the only part that processes human emotions. So the amygdala is not the only part of the brain that causes a person to have certain emotional reactions. For example, the basolateral amygdala (BLA) is bi-directionally connected with the entire cortical sheet where it is closely connected with parts of the frontal and temporal cortex (Pessoa, 2023b). This suggests the amygdala is not the only part to produce emotions.

Based on the understanding of the entangled brain, networks are integrated within the brain where individual brain structures work together dynamically to achieve a flexible picture that is more than the sum of its parts. This means that the brain does not simply consist of separate parts with specific functions, but rather as an interconnected network where dynamic collaboration between the parts occurs continuously (Cavanna et al., 2023). For example, regarding the annihilation of fear, the human brain operates through information flow that is multi-directional rather than hierarchical or one linear direction. When the conditioned stimulus no longer predicts an unpleasant event, the brain initiates fear extinction. This process involves the medial prefrontal cortex (mPFC) which regulates the amygdala, a major emotion processing center. However, mPFC activity is also influenced by inputs from other brain regions such as the hippocampus that provides contextual information, and the thalamus, which distinguishes between dangerous and safe contexts. The reciprocal relationship between the basolateral amygdala (BLA) and mPFC suggests their coordinated involvement in fear relief, thus challenging the hierarchical model (Pessoa, 2023b). The existence of this bidirectional and dynamic interaction suggests a multidirectional flow of information in the brain during fear extinction, underscoring its complex and interconnected nature.

Luiz Pessoa's findings need to be juxtaposed with quantum entanglement to be well understood. The meaning of entanglement itself is not a property of the state

of a particle, but a shared property (Ornelas et al., 2024). In quantum entanglement, the entangled nature appears in the interaction of subsystems that are unitary in nature (Zyczkowski et al., 2001). There are studies that explain that quantum entanglement is when two quantum systems are strongly connected both in terms of actual results and the strength of their properties (Ronde & Massri, 2021, 2023). In simple terms, quantum entanglement is a state in which various particles are entangled in the sense that they are not a product of the state of a particular particle (Shimony, 1995). So a brain that works entangled is a brain with interrelated parts. This does not mean that one part of the brain causes another part to work. One example is that the cerebellum not only receives input from most of the cerebral cortex but also projects to many, if not all, of those areas (Pessoa, 2023b). Another example is that extensive processing in the temporally evolving, appetite-related human brain demonstrates the involvement of dynamically distributed brain circuits during the processing of biologically relevant information regardless of its valence (Murty et al., 2023). This proves that although human brain circuits are distributed, they are all mutually involved in eliciting certain states in the human brain.

The initial motivation for linking quantum theory to consciousness stemmed from the philosophical implications of the introduction of the theory of inherent randomness, different from previous deterministic views, quantum randomness is considered a fundamental aspect of nature, regardless of human knowledge or ignorance (Atmanspacher, 2004). The concept of quantum entanglement refers to a phenomenon in quantum physics in which the properties of particles become interconnected in such a way that the state of one particle is directly correlated with the state of another, regardless of the distance between them (Alexander et al., 2023). Human is conceptually similar toconsciousness quantum mechanics in that human consciousness can exist outside of human sensory perception (Samarawickrama, 2024). In the past, physicists such as Roger Penrose have proposed the theory that human consciousness could potentially involve quantum phenomena such as quantum vibrations in brain microtubules (Hameroff & Penrose, 2014). In addition, researchers such as McFadden (2020), explored the relationship between consciousness and electromagnetic fields in the brain, suggesting that consciousness is supported by the brain's energy fields.

This interdisciplinary effort integrates insights from physics, neuroscience and other fields of study to explain the nature of consciousness. Therefore, it is not surprising that Luiz Pessoa proposed his research similar to quantum entanglement. Through his studies, it can be stated that the human brain is a complex and integrated interconnected system (Pessoa, 2022, 2023b). The logical consequence that needs to be considered in interpreting the brain working in an entangled manner is that the workings and results of the brain become difficult to predict, namely humans become difficult to understand how the human brain works. Just as quantum physics, the more it is understood, the more confusing it becomes, so does the human brain. Richard Feynman as one of the physicists who developed quantum mechanics stated that the more quantum physics is studied, the more it is realized that many things are unknown. His words are if you think you know quantum mechanics, you don't understand quantum mechanics. Richard Feynman himself claimed that he did not understand quantum mechanics (Colwell, 2002). The

concept of a brain that works like quantum entanglement presented here is actually a matter of reflection for marketing practitioners who think human behavior can be predicted with certainty.

Pessoa (2023) states that when a conditioned stimulus cannot predict a paired unconditioned stimulus in the past, the conditioned stimulus gradually stops eliciting a conditioned response. This statement explains that an instrument that is usually used as a definite reference in predicting may not be able to explain a certain event. The thought of Pessoa's research is material for reflection, namely that it cannot be arbitrarily stated that certain things have caused certain events. This is because something that is thought to be a cause may turn out not to be a cause or just one factor among many. For example, one cannot simply say that X caused Y because there could be a variety of other factors that caused Y. Given that different parts of the human brain work simultaneously, it is difficult to predict which part is most dominant in bringing about a particular situation because it could be that all parts of the brain are proportionally responsible or one is stronger than the others. In terms of determining the exact cause, it is difficult to state accurately. For example, the classical basal ganglia work in a non-independent manner, communicating with and relating to other parts (Pessoa, 2023a). Just as there are various people working on a project and it is difficult to determine which one is most dominant in its success, it is also not possible to determine the extent to which the classical basal ganglia play a role in eliciting certain reactions in the human brain.

In the past, Pessoa has (2014) shown that cognition and emotion are closely related and cannot be neatly separated into different categories in the brain. Rather than viewing cognition and emotion as separate entities, he suggested that there are complex interactions between these processes. Cognitive-emotional interactions in the prefrontal cortex take various forms. He states that the lateral prefrontal cortex is responsible for both cognitive and emotional processes and influences each other in complex ways. As such, it is difficult to say for sure whether the amygdala is dominant in eliciting a person's emotional reactions or the prefrontal cortex, which is generally considered the rational part of the human brain. The study shows that emotion is not necessarily more dominantly done by the amygdala or cognition is more dominantly prefrontal cortex. In addition, it states that emotion and cognition themselves are difficult to distinguish clearly (Pessoa, 2014). This means that decisions that are considered emotional may be rational, and vice versa. In other words, not only is it difficult to predict which part of the brain is most dominant in working on a particular reaction in the human brain, but also the decision output that is raised is also difficult to label as a rational decision or even an emotional decision.

In the context of fear annihilation, the properties of circuits or networks in the human brain can change the fear-inducing stimulus back to a neutral status. However, there are also many stimuli that have the opposite effect (Pessoa, 2023). This further shows how the workings of the human brain are difficult to know with certainty because a single stimulus can present various reactions. Nonetheless, patterns of brain activity can still be recognized such as a study that used functional magnetic resonance imaging to understand subjective thoughts such as self-

relevance and valence (Kim et al., 2024). In addition, just as quantum mechanics can still be studied, despite the confusion that comes with studying it, so too can studying how the human brain works. So a conceptual framework based on the foundation of the entangled brain can still be built. However, what is different from other conceptual frameworks that offer certainty, the conceptual framework in this research based on entangled brain research explains the potential for random events or events of things that cannot be predicted with certainty. The complexity makes it difficult to predict the decisions made by the human brain.

As researched by Luiz Pessoa (2022), the complexity of how the human brain works states that it is difficult to make predictions with certainty, including determining whether an action is based on emotion or rationality. He also explained that there is no clear boundary between emotion and rationality, as it is stated that the part of the brain that is considered the emotional brain and the part of the brain that is considered the rational brain are reciprocally or non-linearly related. Similarly, consumer interactions in the metaverse are also difficult to predict whether they are based on rational or emotional decisions. If dominated by emotion, are there certain tastes that are pre-existing in their brains, as stated in the view of determinism. What a person experiences in the real world can also be experienced when they interact in the metaverse. Moreover, the metaverse is simulated to resemble the real world but in a digital format (Mohamed & Bukhari, 2023). The nature of the metaverse is dynamic and full of uncertainty (Sun & Wåhlström, 2022). As it is stated that the human brain can produce uncertain decisions due to the complexity of the interaction of various parts in the brain, coupled with the uncertainty contained in the metaverse, the possibility of uncertainty in decision making is also greater.

So if a person often makes decisions that are unusual or do not make sense to others in the real world, the same thing happens in the metaverse, and the uncertainty is even stronger in the metaverse, increasing the chances of making decisions that are strange or cannot be accurately predicted. When the complex human brain capable of making random decisions meets the uncertain metaverse, it is important for all parties to anticipate the increasing level of uncertainty. This encourages the development of a frame of mind that considers multiple variables, not just a narrow one. In other words, it is important to "expect the unexpected" (McDowell, 2019). This does not mean that there is no need to anticipate an event, but rather the opposite: to consider a range of potential things that can be thought of, even if the chance of the event is small or has never happened. The view that the way the human brain makes complex decisions is not a reason not to study consumer behavior.

In addition, the ventrolateral prefrontal cortex (VLPFC) contributes to behavioral regulation, particularly in response to unpleasant stimuli (Shiba et al., 2016). If the content elicits negative emotions or conflicts with personal values, the VLPFC can inhibit impulsive reactions and guide decision-making towards more adaptive responses. On the other hand, as the brain is entangled, individuals may respond differently. The role of supervision in decision-making is not localized to one area of the brain but involves a complex network of interconnected regions, including the intraparietal sulcus, anterior insula, and amygdala, which regulate

information flow and integrate data during the decision-making process (Pessoa, 2004, 2017). Although the entangled brain differs from the determinist framework in that it does not address the complexity of the parts of the human brain, the determinist view is not totally wrong. Determinism does seem to make it easier to predict human decisions. For example, the emotional brain can impact the next decision a person makes (Katahira et al., 2015). Using the determinism perspective, it can be stated that this happens because the amygdala as a part of the brain that has been designed to build emotions or certain parts of the brain.

Still with the determinism perspective, if a person likes a certain object, this can be stated to be the result of a pre-existing appetite where the emotional part of the brain gives rise to the appetite. The cognitive brain is responsible for post hoc reasoning to justify the emotional appetite. For example, a person who sees a painting, for a short period of time, likes it in his mind. But when asked the reason for liking it, the person thinks first to find a justification. This is called post hoc reasoning, where rationality acts as a lawyer rather than a judge, trying to justify a predetermined emotional taste that has been in the brain for a long time. Just as babies whose brains have been designed from the start are able to crawl without having to be taught including having the ability to speak (Notiviara et al., 2023), so are pre-existing tastes. That is, if someone feels that a painting is good because of its color, then the taste for that color has been there from the beginning. In determinism, a child's ability to imitate a parent's speaking style is due to a variety of predetermined factors, although this ignores the complexity of the human brain and the simultaneous interaction of different parts of the brain.

One of the neuroscientists who popularized the view of determinism is Sam Harris. He states that the human brain acts based on predetermined variables (Harris, 2012). Although Sam Harris holds to compatibility in the aspect that humans can distinguish voluntary and involuntary actions, but for free will it is different (Dennett, 2017). Among these perspectives, compatibilism suggests that free will and determinism can coexist (Dennett, 2017). The compatibilist view holds that responsibility for one's actions depends on mental faculties, including clear thinking and rational judgment (Vincent, 2015; Vokov, 2014). Compatibilism presents a synthesis of determinism and libertarianism. That is, the compatibilist view recognizes that there are positive sides to both extreme views. So this research also seeks to provide a synthesis of determinism, libertarianism and compatibilism based on a conceptual framework based on the entangled brain as the main foundation.

Referring to the concepts of entangled brain and determinism, it can be stated that although the parts of the human brain work in a complex and interconnected manner, this does not mean deter. The integrated nature of brain function allows for complex interactions between its various components, yet each action or response can still be traced back to predetermined factors, including internal conditions, past experiences and environmental influences. However, uncertainty can occur due to the complexity of the brain system and the many variables involved in decision-making. The chances of uncertainty can be even greater if one interacts with technologies that also present uncertainty such as the metaverse. Just as the compatibilist perspective is used to reconcile libertarianism and determinism, so is

the concept of entangled brain and determinism. The libertarianism view recognizes human free will so that it can be used to explain the potential of decision-making that is not confined by various factors such as genetics and other related factors. This leaves room for the recognition of events that are unpredictable or have a small chance of occurrence. As determinism recognizes causality, it can be stated that the cause of these events is the complexity of reciprocal interactions between parts of the human brain.

Although this research with the entangled brain framework does not completely eradicate determinism but rather embraces it, it still explains the importance of not prematurely determining causal relationships. For example, stating that a consumer's experience before using the metaverse determines their purchase decision when viewing content shared on the metaverse. Referring to the entangled brain framework, the unexpected can happen. It could be the opposite, that content in the metaverse actually impacts consumer experience. For example, a certain group of consumers feel that they have had a positive experience when using a certain service. But when they see content in the metaverse, their positive impression of their past experience changes. As a result, they perceive their experience as negative. Individuals who feel they have had positive experiences may be influenced by certain information. For example, they may view the experience of eating a certain food as a positive experience because it is delicious, but end up viewing it as a bad experience due to information that the food is unhealthy. The above illustration explains that experiences that are thought to be causal factors do not necessarily have an effect, but they can be influenced by content shared in the metaverse.

Companies need to be careful with content from other parties or content from their own company so as not to bring up the worst possible event. This illustration proves that causal relationships should not be arbitrarily built, given that the human brain is complex and reciprocal, i.e. non-linear. This research presents a conceptual framework that uses the entangled brain findings as a foundation that can be unified with determinism, libertarianism, and compatibilism. The concept of compatibilism is used as a justification to unify two perspectives that are antithetical to each other. Just as contradictory views can be synthesized, so should views that are different but not contradictory in the extreme be integrated. Thus, the findings of this research also suggest that the conceptual framework of the entangled brain can be the foundation of neuroscience along with determinism, libertarianism and compatibilism itself to explain consumers' interactions with the metaverse.

CONCLUSION

Conceptual frameworks derived from neuroscience offer a multifaceted lens to understand the complexity of human behavior, particularly in a rapidly evolving technological landscape such as the metaverse. By integrating the concept of entangled that are integrated to bring relevant and up-to-date understanding of neuroscience, this research presents a comprehensive understanding of the intricate workings of the brain and its interaction with the external environment that is the metaverse. *brain* as the main core framework, including also reinforced with determinism although it has differences with entangled *brain*, as well as

libertarianism, and compatibility as perspectives This research is expected to provide a comprehensive understanding in the study of consumer behavior. The concept of the*brain* underscores the integration of different regions of the brain which is akin to *quantum entanglement*. It highlights the non-linear and *reciprocal* nature of neural processing, where stimuli and responses are shaped by complex interactions among different brain areas. This conceptual framework challenges the traditional deterministic view by emphasizing the opportunity for uncertainty to arise in the decision-making process. While the*brain* is the central concept in this study, the deterministic view is not completely ignored. The research also acknowledges the influence of pre-existing factors such as genetics, past experiences, and environmental influences on decision-making and behavior.

The synthesis of this research shows that although there are many factors that influence people's preferences and decisions, as described in the determinism viewpoint, the process consumer decision-making is influenced by the non-linear and interdependent complexity of the brain. These complex, non-linear and interplaying characteristics of the brain can cause to decisions be unpredictable, similar to phenomena in quantum mechanics. In other words, this study recognizes the existence of predictable decisions and the potential emergence of unpredictable decisions. Just as compatibilism can be used to reconcile determinism and libertarianismcompatibilism , so this study uses as a justification that various neuroscientific perspectives can be combined so that*brain* research and determinism are integrated as the conceptual framework for this study. In addition to determinism, libertarians introduce humans as having free will which means recognizing the potential of humans to make choices without having to be determined by certain determinants. perspective This highlights the agency of individuals in shaping actions and responses autonomously, . allowing to humans make free decisions

Similar to the*brain* that implies the human tendency to make unpredictable or unpredictable decisions, the libertarian also perspective allows the same thing. This is because the libertarianism perspective claims free will where free will means allowing for unpredictable things that humans can decide to do. By integrating these diverse perspectives, this research builds a robust conceptual framework that not only explains the complexity of human behavior but also provides insight into the various interactions between individuals and new technologies such as the metaverse. This framework underscores the need for an adaptive and holistic approach in understanding and anticipating consumer behavior in an era characterized by rapid technological advancement and increasing uncertainty.

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