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Navigating Modern Decision-Making: Unraveling the Effects of Variables and Biological Factors

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ABSTRACT

According to a survey of people in New York, “71 percent wish they had more guidance when it comes to making large life decisions”. This number commonly prevails throughout the world as it’s a common issue. This may be caused by so many different factors such as sleep, diet, stress, social environment, etc. A human’s well being can have an influence on their neurotransmitter level(Dopamine and Serotonin), causing a disruption in the decision making process. Maturity is also a big factor because the way your brain works changes based on how much the prefrontal cortex developed. The study emphasizes the different influences that may prevent one from making effective decisions and how to start making better ones. Research done from previous studies is analyzed and put into context with decision making. It was proven that the opinions of people around one when making a decision will make the individual conform to the majority. The majority is not always right: thus, it is important for one to think through their choice and decide for themselves. When analyzing all the research and studies, it is illustrated that making the best decision is by slowly unraveling all the variables and making a humble choice. People who tend to act quick and take impulsive decisions end up regretting them later according to experiments. Decisions have a profound impact on people’s daily life, so it’s important to recognize the factors that may influence them and make decisions to the best of one's ability.

Introduction

The brain functions as a GPS to each of your thoughts and actions: ultimately your decisions. The brain is composed of various components; this includes cortexes with specific functions and neurotransmitters that act as messengers across your body. For example, the prefrontal cortex and sensory cortex serve to collect memories, emotions, and information to make the best decision. However, the neurotransmitters and cortexes can get impacted and alter the way one thinks, leading them to make poor decisions and actions. Some factors include stress, diet, social influence, and genetics: decisions can also be influenced by environmental factors and not just by internal biological processes. As commonly seen throughout today’s world, adults and kids are having difficulty making the right decision: whether they are not mature enough, tired, etc. This substantially impacts their daily lives, and understanding these determinants can provide valuable insights and benefits.

Dopamine is one of the many neurotransmitters found in the human brain. Dopamine’s purpose is to help the brain decide if a goal/task is worth undertaking. In other words, it is a reward-seeking hormone that reveals satisfaction and pleasure. If a neurotransmitter(ex. Dopamine) in the brain is affected, it could alter your decision-making process. A study was done regarding this conclusion at the University of Cologne, Germany in September 2023. Participants were given drugs that changed their dopamine levels; this was done to identify an impact on the speed and accuracy of the candidate’s decisions. Specifically, 31 male participants were divided amongst each other and put in one of the three conditions: a high dopamine release, lower dopamine release, or the control group with no change. This allowed the scientists to distinguish the participants’ brain activity and assess the effects of varying dopamine levels through MRI scanning. Through this experiment, the researchers were able to conclude that participants with excess dopamine(participants who were drugged) increased their speed factor but substantially lowered in accuracy when given a

task. Conversely, the control group was shown to have a higher balance in both sections, ultimately performing better. Therefore, this international study shows that an irregular level of dopamine can have a major influence on the speed and accuracy of a decision.

Besides neurotransmitters which every human has, culture and genetics are factors that each individual differentiates from. Culture is also one of the key ideas that has to be taken into consideration as it has a huge influence on one's decisions. Based on where someone comes from, they could endorse different beliefs and see the world differently than another person: ultimately making a decision differently than others. This hypothesis was tested in an experiment led by researchers at Yale University in 2023. Over 500 individuals from diverse backgrounds were gathered together and were given tasks that consisted of rewards with a factor of risk. The study's results were clear; individualistic cultures (prioritize themselves and their thoughts over those of others) and collectivist cultures(prioritize the needs of the groups over their own) had a different style of making their decision. Since each individual from a different culture is brought up differently and follows different principles, the brain decides what is best for them and what they believe will benefit them the most. Thus, understanding the influence of genetics and cultural background is crucial when analyzing how a person may make a faulty decision.

Social conformity is a human behavior where an individual changes their own belief or decision due to the majority and to fit in with the rest of the group. Environmental factors like noise levels, lighting, and temperature are impactful factors when making a decision as well. These behaviors and ideas were demonstrated in an experiment done in New Jersey. Over 150 individuals from different demographic backgrounds came together and were all asked to decide on one scenario. The conductors of the experiment wanted to analyze the impact of environmental factors on their decisions. For example, they changed the noise level, lighting, and temperature in their background to put this to the test. The researchers found that the ambient noise, poor lighting, and extreme temperature all were distractions and led the participants to make poor decisions. Additionally, an important takeaway from the study was that when a decision was made by one person, others tended to follow the majority, regardless of whether the decision was correct, rather than making an independent choice. Environmental factors and the surroundings of an individual while making a decision could significantly change their approach and thought process.

As humans, it is our responsibility to make decisions every single day for pursuing an action or going on about the day. It may be a big, important decision or also a small, everyday choice. Regardless of its significance, it is crucial that it is beneficial and reasonable. However, many of us today need help to make choices that would maximize the benefits as we aren't seeing the potential in effective decision-making. Understanding various ways decision-making can be influenced and gaining a general overview of how it works could help people avoid certain things and start a habit of good things, ultimately leading them to make better choices.

Methodology

The focus of this study was to emphasize the influences of decision-making as it could make a huge impact on one's life. Many factors including, changes in neurotransmitters, stress, culture, and genetics can change a person's choice. This paper comprises a review of relevant literature and complicates this study, which was previously done by other acknowledged individuals. This was not an in-field study so no physical tools or materials were used. All analyses were conducted using online sources such as published articles, experiment results, etc. No ethical considerations were observed throughout this research, and it was primarily done for education purposes. No new findings were found, but ideas were strengthened and incorporated into the study on this topic. Multiple primary sources were used to accentuate the decision-making factors and allow the audience to inform themselves of some negative influences: essentially, how to start making more effective ones.

Literature Review

The Biology of Decision-Making

Decision-making is simply the process of making a choice. However, decision-making often isn't easy and can be particularly complex in an organizational context(Aaron De Smet, 2023). The result could come off as effortless, but a brilliant process occurs and many different variables lie in altering a decision. First, the brain organizes all our previous memories with a connotation. The different regions in a brain including the hippocampus and prefrontal cortex (PFC), exchange different information with each other regarding the risk, reward, and goal to make a decision. The neurotransmitters in the brain play a key role in weighing out all the different factors in the decision and making a choice that is the most beneficial. This process is not as easy for everyone, and even worse, people may be making "bad" decisions for themselves unknowingly. It is not only that they are thinking through different options but also because of different influences around them and their background. After all, studies suggest that 20% of the world population (only including adults) is indecisive. That's nearly 2 billion people already, and imagine how many more kids face this trouble. As kid's brains have not fully developed yet, they will be facing this more frequently and it has to be addressed because as they grow up, this will be their foundation. The more they grow up, the more important decisions they will have to make: with money, family, health, themselves, etc. Therefore, it is important for humans to acknowledge how this process works biologically and the factors that could influence this both negatively and positively.

Decision-making is a complex process that occurs in your brain using your memories, intellect, and opinion to make a beneficial choice. Knowing this procedure could help give insight into how to make a better choice. Different regions of the brain work together and trade information, but this could be hard for humans to understand. Thus, researcher Moghadam and her team conducted an experiment where they were able to learn about the ins and outs of this process. They were able to model the interactions between different cortexes in the brain and understand this process using high computer algorithms, a Model Predictive Control(MPC), and an Object-Oriented Modeling(OOM). The model below could be broken down to fully understand and visualize the concepts being portrayed, The Model Predictive Control(MPC) was a major part of the model because it played the role of the controller. It was a working tool in the model because it kept formulating the dynamics of the decision-making process. The researchers show the starting point from where a person has to make a decision; the set points are ultimately the goal and what is beneficial. The cost function is needed to tell your brain what needs to be changed or modified from the original. This plays a significant role in decision-making because it allows a change in the outcome. In the model below, constraints are a category giving insights into the limit since the choice has to be reasonable. Once the knowledge is transferred between these, the optimizer compares the pros and cons of each decision. It finds the best decision with the least amount of effort. The model predictor predicts future outcomes based on past experiences, ultimately improving this process in each interval. The model demonstrates that the outcome of the Model Predictive Control(MPC) goes to the Decision region where the Prefrontal cortex(PFC) and Memory(Hippocampus) are located. The Prefrontal cortex and Hippocampus retrieve memories and patterns(A_E_L_H) to facilitate this process. With all this retrieved information results in a final decision. The variables shown in the model demonstrate the factor of the feedback loop. Each complete loop results in an increase in memories and patterns, thus improving the goal of an effective decision each time(Sohrab et al., 2019). This model gives a precise perspective of decision-making and illustrates the various factors that need to be accounted for. The biology of decision-making is essential to understanding different factors that may alter a decision and providing solutions to being "indecisive".

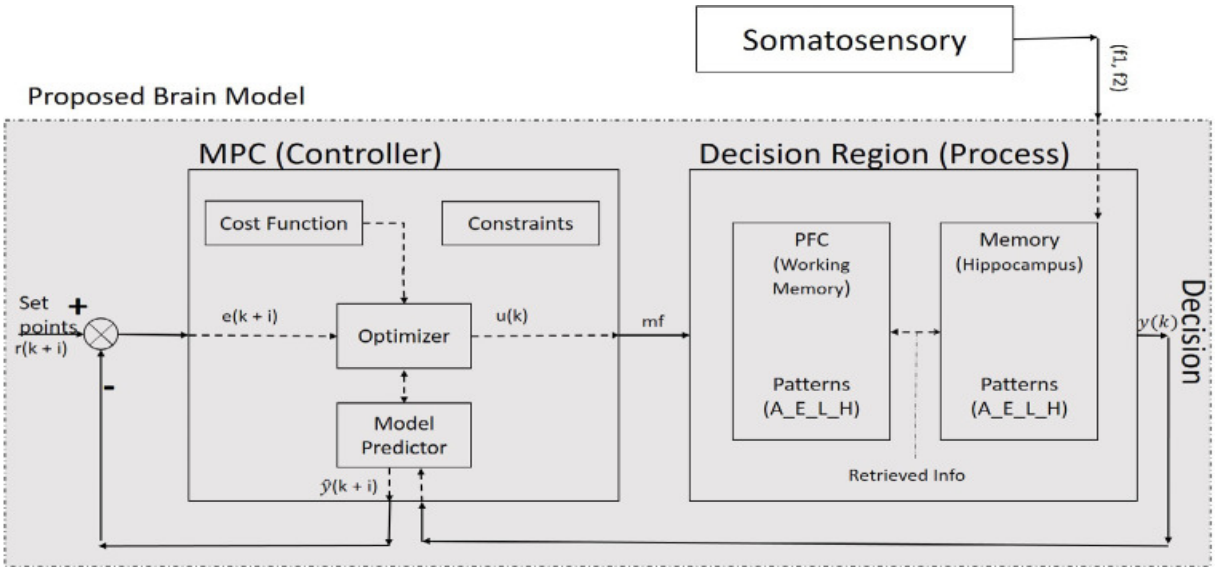

Figure 1. Source: National Library of Medicine: An Algorithmic Model of Decision Making in the Human Brain Description: Proposed model for a closed-loop system of the spiking neural network: a decision-maker(Sohrab et al., 2019)

Influence of Neurotransmitters in Decision-Making

Over 100 different types of neurotransmitters are present in the human body, each correlating to a different purpose. They send chemical messages from one neuron(a single nerve cell) to another, making them a requirement for the body to function. The neurotransmitters are primarily located in the nervous system as they are needed for multiple actions that are automatic(involuntary) and purposeful(voluntary) actions. These signaling molecules are used when making a decision and facilitate the process. Each neurotransmitter is present for a different function and releases emotions/messages through your body, signaling what would benefit them. They help you learn new material, get pleasure from reality, and regulate your mood often. However, an excess or regulation in a specific neurotransmitter can negatively alter your decision-making process and overall body. It is important that all neurotransmitters are present in the brain and are reasonably regulated, so a person's decision-making process can reach its potential.

Serotonin

In a study conducted by a pharmacological experiment, it was found that the levels of neurotransmitters showed a great influence when compared to the control group. For example, when serotonin was given to a participant, it revealed that although the results were inconsistent, the person was more likely to account for the bad outcomes and risks(Rogers, 2011). When the researchers gave drugs containing this substance, they found that they were more likely to pay attention to the consequences and make better choices in a social context. Tanaka and her team set up an experiment to evaluate the influence of serotonin on decision-making. As seen below, there were three participants each having a different condition. One person has reduced serotonin levels(Tryptophan Depletion), another has increased serotonin levels(Tryptophan Loading), and lastly one has maintained neutral levels(Neutral Tryptophan-Balanced Condition). As seen on the left side of the model, choosing the white square gives lower rewards than if one chooses the yellow square. With each attempt, the pattern and location of the squares change, making the task harder with a limited time. Additionally, the researchers conducted Functional magnetic resonance imaging (fMRI) to show the influence of serotonin. The red-to-yellow spectrum meant that this region of the brain favored rewards that

occurred in a shorter period while the green-to-blue spectrum suggests that the region favored delayed, bigger rewards. By conducting this study, they were not only able to identify which regions correlate to different types of rewards but also how the serotonin neurotransmitters play a role in making the choice. Using functional magnetic resonance imaging (fMRI) specific color-coded regions were modeled with the participant's brain(Rogers et al.,2011). The different colored regions were correlated with the participant's conditions. For instance, the participants who had the condition of Tryptophan Depletion (reducing serotonin levels had red-yellow regions because it was found that they were more likely to make more impulsive decisions even for small rewards. Meanwhile, the participants with Tryptophan Loading (increasing serotonin levels) corresponded with the image of green-blue regions since they were influenced to choose more "delayed" larger rewards over small impulsive rewards.

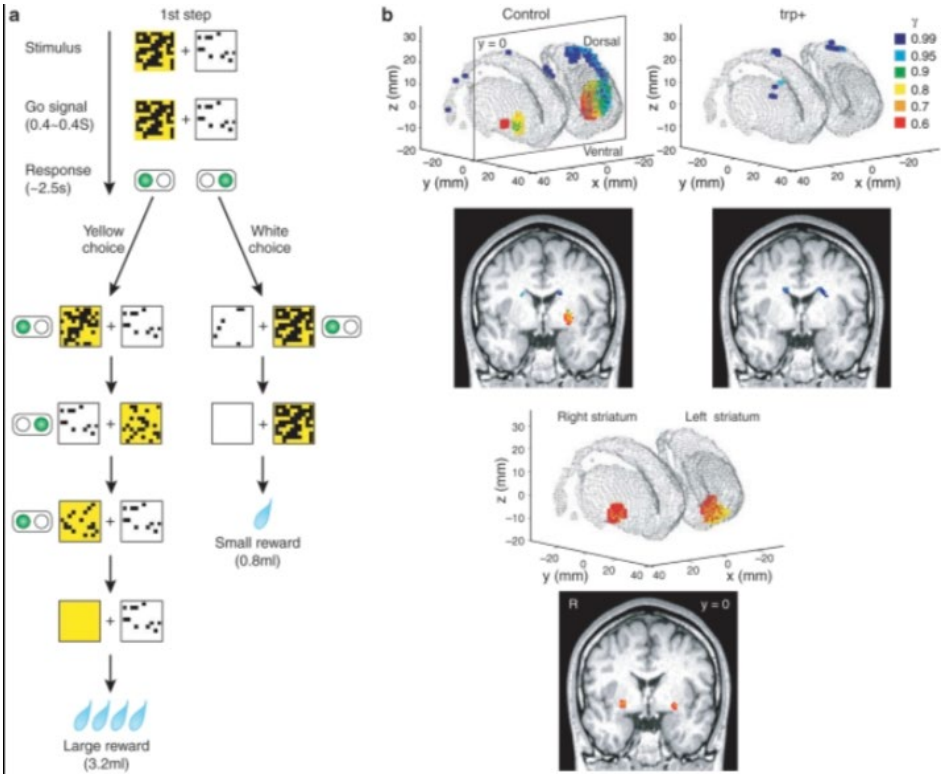

Figure 2. Source: National Library of Medicine: The roles of dopamine and serotonin in decision making: evidence from pharmacological experiments in humans**.** Description: Task and striatal value signals at different delays as modeled by Tanaka *et al* (2007)

Factors in Decision-making

There are many factors in decision making including background and the environment surrounding one person which can influence their choice. Their background such as culture and genetics could play a key role in changing the way they approach a problem and how they go about it. Similarly, the environment around you is also an influence because you may be persuaded to follow the majority or the wrong path of others. Rollo May once said, "The opposite of courage in our society is not cowardice, it is conformity". Overall, a person has to be careful when making a choice, whether it's big or small, as it would impact them in some way. Acknowledging the factors influencing your decision is crucial: making your own choice at ease leads to the best choice made.

Traditional VS Environmental Influences

Traditional factors include culture and genetics, whereas environmental factors include the physical surrounding influences. A study was done in Tokyo, Japan by researchers to compare the differences between environmental factors and non-environmental factors(genetics). One group consisted of a pair of monozygotic (MZ) twins and another consisted of a pair of dizygotic(DZ) twins. Therefore, they were put to the test if their type of genes would result in a specific type of decision. However, since they all had different individual experiences, the researchers also analyzed if this difference would impact their decisions.

Table 3

Parameter estimates for the best-fitting model.

Category	Threshold	r_{MZ}	r_{DZ}	Genetic (A)	Shared environmental (C)	Non-shared environmental (E)
AD/non-AD	0.01	0.24	0.12	0.23	–	0.77
				(0.08, 0.37)		(0.63, 0.92)
BD/non-BD	0.62	0.36	0.18	0.36	–	0.64
				(0.19, 0.51)		(0.49, 0.81)

Figure 3. Source: National Library of Medicine: Genetic Factors of Individual Differences in Decision Making in Economic Behavior: A Japanese Twin Study using the Allais Problem Description: The model used in the study to assess the genetic and environmental influences on the decision-making response

In the table above, the results of the experiment and the overall takeaways are illustrated. The two groups(AD/non-AD and BD/in-BD) are shown with the genetics and environmental influences. The first group had a smaller genetic influence as they were the Dizygotic twins; they both came from different eggs meaning they had fewer gene shares. Therefore, the environmental influence when they were asked to make a choice was shown much more prominently(0.77%). Meanwhile, the monozygotic twins were shown to have 36% of their decisions related to genetic influences and only their environmental influence of 64%. Overall, the researchers ultimately found from all their analyses that genetics and their cultural influence were close to none. Even though a lot of the similar genes were charged between the groups, it didn't seem to make an impact when each one individually made their choices. On the other hand, the researchers found that environmental factors like their past experiences had a crucial role in making their decisions. As they all were raised a bit differently and experience things uniquely, they all will approach a problem differently: making different decisions.

Chizuru Shikishima, the primary researcher, wanted to emphasize that regardless of where you are from, the social influences around a person are what is going to impact their decision. As demonstrated in the study, even though the two pairs of twins were compared with their decisions, their shared genetics didn't play a significant role. As each person experiences new things, they will start to approach their problems differently than others. However, it is important to not be negatively influenced by your environment. People should be cautious when making a decision and pay attention to their surroundings at all times as one's social environment can impact them the most. Instead of

thinking about what is best for others and what they would want, start thinking about what you think you prefer and what is right.

Mastering the Art of Decision Making

Decision-making is a difficult task; there are so many ways this process could be influenced. However, it is crucial to make good ones since they make some form of impact in your life daily. Napoleon Bonaparte once said, “Nothing is more difficult, and therefore more precious, than to be able to decide.” As previously discussed, people of all ages should learn how to make decisions effectively because it allows them to navigate through the challenges they encounter. The cultural factor is not necessarily a negative aspect in making a decision, but it clearly shows how one may think differently compared to one of a different culture. On the other hand, the environmental factor can influence your decisions negatively because a person can easily be manipulated by his surroundings or also confront the majority around him. Kids are very vulnerable to this because their minds aren’t fully mature and think that the majority is always right. It is important to always do what you think is right regardless of what the people around you think. It is tempting to align thoughts with others, but if everyone does this, everyone will be wrong. Instead, people should think through the decision, see the benefits and concerns, risk, and make a clever decision.

In research done by Daniel Kahneman(2011), the key details in making effective decisions are shown. Daniel separated people into two groups, one who makes fast decisions out of instinct, while the others are slow and think through a decision. When asking them to make a choice, he analyzed which choice was the best and compared it to what groups chose. He stated that at different times you need to know which type of method to use as they each have their benefits. If you are stuck in the middle and it is a small decision, you should trust your instinct instead of overthinking. Overthinking will unnecessarily stress your brain out for no particular reason. On the other hand, when a big decision comes, it is more beneficial to think through the choice for some time. A person must consider all the factors in the decision and how it would influence them since it will most likely have an impact on their lives. Additionally, the research also proposed the negative aspect of overconfidence. Although it is shown to boost your motivation, it is proven that one will tend to make more risky decisions. In the end, these decisions are not ideal because they are based on luck and anything can go wrong. It is important to identify the right time to make a specific type of method and be aware of the potential influences that come in the way.

The image below elaborates on cognitive ease which is essential to attain in decision making. This image was constructed in Daniel’s research paper, to show the significance of having ease when making a Decision. When in a good mindset and have a clear mind, you will be able to take action with pleasure. This will result in your decisions being very effective and beneficial to you. When comparing the two groups to each other, he determined the aspects that give a person a clear mind: no influences or distractions, having a good mood, and being provided with simple information. These factors allow a person to have a calm mind, thus making better choices. The table below shows what brings ease on the left side, and what ease results on the right side. This concept is crucial for people of all ages in starting to make better decisions. Many people today are very busy and are always being “compared” with others. This is one of the primary causes of people not being mature in their choices. Therefore, this new proposal should be taken into account for the future, as people are making choices every day that impact their lives.

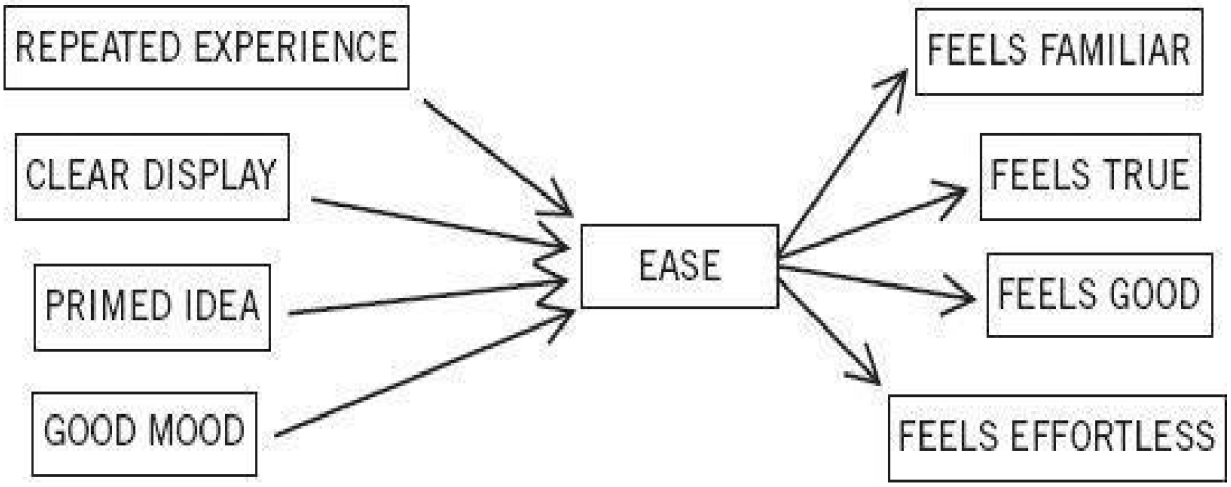

Figure 4. Source: Kahneman, D. (2011). *Thinking, fast and slow*. Farrar, Straus and Giroux. Description: Causes and Consequences of Cognitive Ease by Kahneman *et al* (2011)

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