# Understanding neural mechanism of decision making on approach- avoidance conflict paradigm

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## Papers read:

- **Toward an Understanding of Decision-Making in Severe Mental Illness:** The research paper "Toward an Understanding of Decision Making in Severe Mental Illness" explores the impact of severe mental illness on decision-making abilities. The authors argue that individuals with severe mental illness may face decision-making challenges due to cognitive impairments, lack of insight, and social isolation. The paper highlights the need for interventions and support to help individuals with severe mental illness make informed decisions and lead more fulfilling lives.

**It's related to our work** as a part of the section talks about decision-making in anxiety disorders. Anxiety is a natural response to risk and uncertainty, mediated by the amygdala, insula, and DLPFC. Fear and anxiety share similar properties but differ in their duration and trigger. Anxiety is associated with attentional biases towards negative information and negative interpretation of ambiguous stimuli. Individuals with high trait anxiety tend to be more risk-averse and show altered circuitry involved in learning and regulating conditioned fear. Anxiety disorders are characterized by negative attentional biases and amygdala hyper-responsivity, leading to avoidance behaviours that can impact an individual's ability to adapt.

- **Measuring maladaptive avoidance: from animal models to clinical anxiety:** The paper discusses the different methods used to measure maladaptive avoidance behaviour, a core symptom of anxiety disorders. The article reviews animal and human studies and presents evidence that avoidance behaviour is a crucial feature of anxiety and stress-related disorders. The authors also highlight the importance of understanding the neural mechanisms underlying maladaptive avoidance behaviour and suggest that a better understanding of these mechanisms could lead to more effective treatments for anxiety disorders. Overall, the paper provides insights into the importance of measuring maladaptive avoidance behaviour in animal and human models and its role in developing and maintaining anxiety disorders.

**It's related to our project** as the paper discusses maladaptive avoidance, a core symptom of anxiety disorders. Maladaptive avoidance refers to the tendency to avoid situations or stimuli that are not objectively dangerous or threatening but are perceived as such due to anxiety. In anxiety

disorders, individuals may have a heightened sensitivity to potential threats, leading to maladaptive avoidance behaviour. Studying the neural mechanisms of decision-making in approach-avoidance conflict can help us understand how the brain processes information about potential rewards and threats and how this information influences decision-making in individuals with anxiety disorders.

- **Costly avoidance in anxious individuals: Elevated threat avoidance in anxious individuals under high but not low competing rewards:** The study examined how anxious individuals behave in situations with threats and rewards. The researchers found that anxious individuals avoid threats more often than non-anxious individuals, especially when the potential rewards are high. This suggests that anxious individuals may be more sensitive to the potential costs of avoiding threats and that this sensitivity may interfere with their ability to pursue rewards.

**It's related to our project as** this paper is directly related to understanding the neural mechanisms of decision-making in the approach-avoidance conflict paradigm.

The study investigated how anxiety affects avoidance behaviour when there is a conflict between approach and avoidance motivations. Participants were presented with a choice between a high-reward and low-reward option, which was also associated with a potential threat. The researchers found that anxious individuals were more likely to avoid the high-reward option when the potential danger was high but not when it was low. This suggests that anxiety affects decision-making due to competing rewards and threats. The anterior cingulate cortex (ACC) is a brain region that detects conflicts between competing motivations and guides behaviour accordingly. In anxious individuals, the ACC may be hyperactive, leading to increased avoidance behaviour in response to potential threats. This study provides insights into how the brain processes conflicting motivations and how anxiety affects decision-making.

## Other papers discussed in the discussion hour are:

- **The biology of fear- and anxiety-related behaviours**
- **Comparing measures of approach-avoidance behaviour: The manikin task vs two versions of the joystick task**
- **Approach/Avoidance**

**Unity work done:** I worked on Unity to tackle the game's challenges. In the initial weeks, I went through the basics of C# and got used to the interface of Unity. For C#, I referred to W3 Schools, and for Unity referred to YouTube tutorials. Later I tried to create my own first-player movement game involving the interaction of two objects. I worked on script writing, camera components, x and z movement, and speed control. I skipped drag, jumping and air control as it was irrelevant to our game.

- **Camera:** For mouse movement along the x-axis, the camera moves horizontally, and for movement in the y-axis, the camera moves along vertically. Cursor is locked at the centre and made invisible. Later Add x input to y rotation and subtract y input from your x-rotation. The player is rigid-body. The camera is put into a separate camera folder because having a camera on a rigid-body object can be buggy. We put the camera position object inside the object for the first-player perspective. In the end, add the camera script( written in C#).
- **Movement:** In the script, variables movementSpeed, horizontalInput, verticalInput and Vector3 for movement direction and the reference for rigid-body. We create an input function for the keyboard inputs. Create the movePlayer function; we want to calculate the movement direction by creating a Vector3 object. We use rigidbody.force in the direction calculated above to add force. Important: we need to call the movePlayer function in the function fixedUpdate.
- **Speed:** We can change player speed by assigning different values to the variable move Speed.

These are basic yet crucial steps involved in the game. Our current game is much more complex than a basic game and consists in importing assets for different components like graphics and player.

**The things which we need to figure out next are:**

1. Joystick control for the game
2. VR control for the game (I have the tutorial for the same HTC Vive VR we have in our lab. Now, we need to follow the tutorial steps and try and experiment with different settings to add the VR component to our game.)
3. Collecting data from the game, we need LSL for this.

Some other minor changes which need to be fixed, which we noticed on using VR for the game, are:

1. Currently, the camera rotation is inverted; we need to debug the script of the main camera object.
2. The rotation sensitivity is less( for example, on rotating the head 90 degrees, there is only a 40-50 degree camera rotation. Again this can be debugged by inspecting the camera script.
3. When the player gets a penalty, the brightness is too high during the lightning, which causes eye strain when viewed by VR. Need to fix this, but currently need to learn how to do this. Need to refer to the graphics components for this.