ANTICIPATION: CONSCIOUS AND UNCONSCIOUS BRAIN PROCESSES

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In the present literature review, brain processes and the psychology of short-term and log-term anticipation will be discussed.

Introduction:

When the brain must take a decision, it does not have time to consider all possible alternatives. The brain decides which options are more likely to be realized; it anticipates among formed "internal models" whose task is to guide the system in its decision- behavior. The brain anticipates different alternatives for making decisions (Berthoz, 2003).

Anticipation is the activation of the neural substrates determined by expectation before all conscious and unconscious brain processes that take place for short-term and long-term decisions.

Anticipations are explicit or implicit. Explicit anticipations are those of which the system is aware. Implicit anticipations are unconscious. They may activate the system without the system being aware of them.

Explicit anticipation enables rapid, goal-oriented processing, but it gives rise to the incapacity to perceive things not predicted by anticipation

Anticipation exhibits different temporal patterns, from microanticipations (in miliseconds) to longer forms of social anticipation (in years).

Anticipation characteristics are:

- Anticipation occurs when future outcomes are important and self-relevant (Celsi & Olson, 1988).
- Anticipation results in actions aiming to reinforce desirable future outcomes and avoid undesirable future outcomes (Kotani et al.,2001).
- Anticipation has affective outcomes and anticipated emotions (pleasure experience) while actualizing positive events (Mc Leod & Conway, 2005).

- Anticipation is an active, conscious process, including cognitions, affects, and preparatory actions/behaviors, planning, in long-term goal directed behaviors and has unconscious components (Trevena & Miller, 2002, Hodgkinson et al., 2008).

Anticipation as a goal-directed, active process has 3 components (Riegler et al., 2001):

- Cognitive (planning, imagining)
- Affective (anticipated emotions)
- Behavioral (current actions as preparation to a goal)

While anticipation is defined as long-term, conscious, active, goal-oriented process in many sciences, physiological studies, observing anticipation for immediate events/responses reported short-term, unconscious, goal-oriented active processes during anticipation.

Cognitive Processes and Brain Dynamics in Anticipation

Anticipation forms a Slow Negative Cortical Potential (SCP) before all cognitive processes, during only miliseconds. SCPs might have the function to speed up, strengthen, facilitate and activate the cognitive processes involved. SCPs have been related with motivation, attention, and arousal functions.

Anticipation brainwaves were observed during different cognitive processes:

- Visual attention (Walter et al.,1964)
- Muscle- movement coordination (Komhuber & Deecke, 1965, Low et al.,1996)
- Facial expressions and face recognition (Ran et al., 2014)
- Reward expectations (Van Boxtel & Böcker, 2004)
- Time estimation (Walter et al., 1964)
- Feedback about past performance (Brunia & Damen, 1988)
- Instructions about a future task performance (Gaillar & Van Beijsterveld, 1991)
- Arithmetic tasks Chwilla & Brunia, 1992)
- Affective stimulus (Poli et al., 2007, Simmons et al., 2005)

Scalp Distributions of Anticipation:

Anticipation may be active during information processing and during intermediate processes on the continuum of a multiple tasks situation with increase in activity in specific brain areas before the stimulus onset, represented by slow cortical potentials SCPs. These SCPs are named differently according the specific cognitive processes and the brain locations involved.

Anticipation prepares the systems that will become active soon, in order to reach a more efficient processing. There is no unitary scalp topography for the SCPs. Different types of anticipation show different scalp distributions, reflect differences in the processes that are anticipated, but do not differ in the process of the anticipation itself.. Anticipation is a general purpose process that is evoked at various cortical areas.

The brain might be perceived as proactive in nature rather than waiting to be activated by sensations, it is constantly generating predictions that help interpret the sensory environment in the most efficient manner. These predictions facilitate perception and cognition by pre-sensitizing representations in the sensory brain areas. Repetitive experience will make analogies, associations and the generation of predictions, automatic and will require less conscious effort. Predictions not only facilitate perception and cognition, they play a critical role in action, which is manifested by the sequential representation and execution of action sequences

In higher cognitive levels, predictions have a critical role in language and sentence comprehension. Also, being able to predict the intentions and actions of others is beneficial (theory-of-mind).. Predictions also play a role in how we enjoy art, and music.

The generation of predictions is also manifested in social interactions where we compare current occurences with similar previous experiences, for example first impressions, which takes place in less than 100 miliseconds.

Anticipation Activates the Following Brain Areas (Kvegara & Bar, 2007)**:**

Thalamus, V1, V4 for Perception

Hippocampus for Memory (Bar, 2007)

Frontal Cortex for Visual Processing

Right Hemisphere for Emotional Processing

Amygdala/ Hippocampus for Fear Anticipation and for Negative Situations

Auditory cortex and right frontal cortex for anticipation during auditory task in humans (Obghami et al., 2002, Weis et al. 2013) when:

- Reward expected and received
- Reward expected but not received

- Reward not expected and not received.

Anticipation, "Self" Feelings and Empathy (Decety & Chaminade, 2003)**:**

Emotions formed in the limbic system, and past experiences traced in the hippocampus; form a unique anticipatory "self" feeling for each individual. Past experiences together with conditioned expectations will influence the new future decisions for similar future events. Since the limbic system is involved, these decisions might be emotionally biased rather than objective considerations of the future. As the emotions and the past experiences marked so strongly together form the biased future decisions, they also form our "empathy" feelings for other persons. But the anticipatory "empathy" feelings experienced by "self" will be different than the other persons real experiences and feeling.

Dopamine Activity in Anticipation:

Dopamine activity increases in the striatum in rewarding conditions. Dopamine neurons show brief bursts of increased activity for an unexpected reward in animal studies.

In chained task experiments where the animals receive the reward in the end of all tasks, the dopamine level in the striatum increases steadily, peaking as the final goal is approached, as if an anticipation of a reward. The dopamine signal seems to reflect how far away is the final goal. The dopamine level is also related to the size of the expected reward (Howe et al., 2013).

This internal guidance system, with increase in dopamine levels in every step of a goal, might explain the pleasure and motivation experienced as the goal is approaching. For example sometimes the pleasure of anticipating every step of a piece of art may be more pleasant than the end product itself.

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