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CEREBRAL ACTIVITY - BASED JUDGMENT TRAVERSING NEURO- ENTREPRENEURSHIP

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Prelude

This literature assessment examines the emerging field of neuro-entrepreneurship and argues for a more process-oriented account of entrepreneurial cognition. Traditional entrepreneurship research has generated important insights into opportunity recognition, uncertainty, and strategic decision-making, but it has often relied on retrospective reporting and outcome-based measures that provide limited access to the underlying cognitive mechanisms. In response, neuro-entrepreneurship brings together entrepreneurship, cognitive neuroscience, and behavioural economics to investigate how opportunity evaluation and entrepreneurial decision processes are supported by neural, attentional, and perceptual dynamics. The assessment synthesizes work on entrepreneurial cognition, reward processing, emotional appraisal, executive control, predictive processing, visual attention, and neural oscillations. Particular emphasis is placed on the complementary value of electroencephalography (EEG) and eye-tracking. EEG offers high temporal resolution for examining rapid neural dynamics, while eye-tracking reveals how information is sampled, prioritized, and compared within complex decision environments. Building on these literatures, the assessment proposes an integrated experimental framework in which entrepreneurial decision-making is studied as a temporally unfolding interaction between attention, evidence accumulation, prediction, and decision commitment. The assessment concludes that combining neural and attentional measures can strengthen theory, support more ecologically valid research designs, and open new directions for entrepreneurship education, training, and technology-assisted decision support.

Key Words: Cerebral Activity, Neuro-Entrepreneurship, Electroencephalography and Decision Support.

Introduction

Entrepreneurship has traditionally been examined through economic, behavioural, and psychological frameworks that focus on opportunity recognition, risk tolerance, innovation, and strategic decision-making (Shane and Venkataraman, 2000; Baron, 2004; Sarasvathy, 2001). While these perspectives have produced valuable insights, they often rely heavily on retrospective reporting, behavioural observation, and self-report measures (Foss and Klein, 2012; Mitchell et al., 2007). Such approaches provide limited access to the underlying processes that shape entrepreneurial cognition in real time.

In recent years, the emergence of neuro-entrepreneurship has begun to address this gap by integrating neuroscience methodologies with entrepreneurship research (Nicolaou and Shane, 2014; Krueger and Welp, 2014). Neuro-entrepreneurship seeks to investigate the biological and neural mechanisms underlying entrepreneurial behaviour, including opportunity recognition, uncertainty processing, risk evaluation, and strategic decision-making. By applying neuroscientific tools such as electroencephalography (EEG), functional neuroimaging, and eye-tracking technologies, researchers are beginning to observe the dynamic neural activity that accompanies entrepreneurial thinking and decision processes (Camerer, Loewenstein, and Prelec, 2005; Glimcher and Fehr, 2014). A growing body of work suggests that entrepreneurial cognition involves complex interactions between systems responsible for attention, reward processing, emotional regulation, and executive function (Bechara, 2005; LeDoux, 2000; Miller and Cohen,

2001). These systems operate on rapid timescales and are therefore not easily captured through conventional behavioural research methods. Consequently, neuroscience approaches provide a promising pathway to better understand the mechanisms that support entrepreneurial expertise and decision-making under uncertainty.

Among the available neuroscientific methods, the combined use of EEG and eye-tracking offers a particularly valuable opportunity to investigate entrepreneurial cognition in dynamic environments. EEG allows researchers to capture high-temporal-resolution measures of neural activity associated with cognitive processing, while eye-tracking provides continuous information about visual attention, gaze patterns, and information sampling behaviour (Holmqvist et al., 2011; Luck, 2014). When these modalities are combined, they enable researchers to examine how neural activity evolves in relation to attentional focus and perceptual decision-making (Dimigen et al., 2011).

In the context of entrepreneurship, such approaches may reveal how individuals scan complex environments, evaluate information, detect opportunities, and make decisions under uncertainty. Eye-movement behaviour can provide insights into visual exploration strategies, attentional prioritisation, and cognitive load (Rayner, 2009), while EEG measures can reveal associated neural signatures of prediction, evaluation, and decision formation (Buzsáki, 2006; Cohen, 2014). Despite increasing interest in neuro-entrepreneurship, the field remains relatively young and fragmented (Nicolaou and Shane, 2014). Existing studies often focus on isolated aspects of entrepreneurial cognition, and there is limited integration of neural, behavioural, and perceptual approaches. In particular, relatively little work has examined the dynamic coupling between neural activity and visual attention during entrepreneurial decision-making.

The present literature assessment aims to address this gap by synthesizing existing research across neuroscience, cognitive psychology, and entrepreneurship studies to develop an integrated framework for understanding entrepreneurial cognition through neural and perceptual dynamics.

Specifically, this assessment:

- Examines the theoretical foundations of neuro-entrepreneurship
- Assesses neuroscientific studies investigating entrepreneurial cognition and decision-making
- Explores the role of eye-movement dynamics in cognitive processing
- Analyses how EEG and eye-tracking can be integrated

Assessment proposes an experimental framework for studying entrepreneurial decision-making

By integrating insights from these fields, this assessment aims to provide both a comprehensive overview of neuro-entrepreneurship research and a methodological roadmap for future investigations.

Foundations of Neuro-Entrepreneurship

• Emergence of Neuro-Entrepreneurship

Neuro-entrepreneurship has emerged at the intersection of entrepreneurship research, cognitive neuroscience, and behavioural economics (Nicolaou and Shane, 2014; Krueger and Welp, 2014). The field reflects a broader shift within the social sciences toward incorporating biological and neural data to better understand complex human behaviours (Camerer et al., 2005; Glimcher and Fehr, 2014).

Traditional entrepreneurship research has largely relied on theoretical frameworks grounded in psychology and economics. Early work emphasized personality traits such as risk tolerance, achievement motivation, and locus of control as determinants of entrepreneurial behaviour (McClelland, 1961; Rauch and Frese, 2007). However, empirical support for stable entrepreneurial personality profiles proved inconsistent, leading researchers to explore alternative explanations (Gartner, 1988).

Subsequent approaches shifted toward cognitive models that emphasized how individuals perceive, interpret, and respond to opportunities (Mitchell et al., 2007; Baron, 2004). These models highlighted the importance of knowledge structures, information processing, and decision strategies in shaping entrepreneurial behaviour.

While these perspectives have enriched the understanding of entrepreneurship, they remain limited in their ability to capture the underlying neurocognitive mechanisms that support entrepreneurial thinking. Neuro-entrepreneurship therefore seeks to extend existing theories by examining the neural substrates of cognition and behaviour.

Advances in neuroimaging technologies have played a key role in enabling this shift. Techniques such as functional neuroimaging and EEG allow researchers to observe cerebral activity associated with decision-making, risk evaluation, and reward processing (Logothetis, 2008; Luck, 2014). At the same time, portable and wearable technologies have made it possible to study cognitive processes in more naturalistic environments, bridging the gap between laboratory and real-world contexts.

- **Neural Systems Relevant to Entrepreneurial Behaviour**

Entrepreneurial cognition involves the interaction of multiple neural systems that support evaluation, prediction, and decision-making. Among the most relevant are systems associated with reward processing, emotional regulation, and executive control.

Reward-processing systems, including dopaminergic pathways within the striatum and prefrontal cortex, play a central role in evaluating potential outcomes and guiding behaviour toward desirable goals (Schultz, 1998; Rangel, Camerer, and Montague, 2008). These systems encode the expected value of actions and update these expectations based on feedback, enabling adaptive decision-making.

Emotional processing systems, including the amygdala and associated networks, contribute to the evaluation of risk and uncertainty. Emotional signals can influence decision-making by highlighting potential threats or opportunities, particularly in situations where information is incomplete or ambiguous (LeDoux, 2000; Phelps and LeDoux, 2005).

Executive control systems, primarily associated with the prefrontal cortex, support higher-order cognitive functions such as planning, reasoning, and cognitive flexibility (Miller and Cohen, 2001). These systems enable individuals to integrate information, evaluate alternatives, and regulate behaviour in pursuit of long-term goals.

The interaction between these systems allows individuals to navigate complex decision environments, balancing immediate rewards against longer-term considerations and adapting to changing conditions (Bechara, 2005).

- **From Behaviour to Mechanism**

A key contribution of neuro-entrepreneurship is the shift from describing behaviour to understanding mechanism. Traditional research often focuses on what entrepreneurs do, such as recognising opportunities or taking risks. Neuro-entrepreneurship seeks to understand how these behaviours arise from underlying cognitive and neural processes.

This shift reflects a broader movement within cognitive science toward mechanistic and computational explanations of behaviour (Marr, 1982; Karl Friston, 2010). In particular, predictive processing frameworks suggest that cognition is fundamentally shaped by the cerebral's attempts to minimise prediction error through continuous interaction with the environment (Friston, 2010; Clark, 2013).

From this perspective, entrepreneurial decision-making can be understood as a process of generating and updating predictions about uncertain future outcomes. Entrepreneurs must continuously integrate new information, revise expectations, and adapt their strategies in response to changing conditions.

This mechanistic approach has important implications for both theory and practice. By identifying the processes that support entrepreneurial cognition, researchers can develop more precise models of behaviour and design interventions that enhance decision-making capabilities.

Entrepreneurial Cognition and Opportunity Recognition

Entrepreneurial cognition refers to the mental processes through which individuals identify, evaluate, and act upon opportunities (Mitchell et al., 2007; Baron, 2004). Central to this concept is the idea that entrepreneurship is not simply a function of external conditions but rather emerges from how individuals interpret and respond to those conditions. Opportunity recognition is widely regarded as one of the defining features of entrepreneurship (Shane and Venkataraman, 2000). It involves identifying situations in which resources can be recombined to create value, often in ways that are not immediately apparent to others. One influential perspective on opportunity recognition is pattern recognition theory, which suggests that entrepreneurs can detect meaningful patterns among seemingly unrelated events or trends (Baron, 2006). These patterns may involve changes in technology, shifts in consumer behaviour, or emerging societal needs. Pattern recognition is supported by the development of cognitive schemas, which are knowledge structures that organize information and guide interpretation (Fiske and Taylor, 1991). Experienced entrepreneurs develop schemas that allow them to recognise opportunity patterns more efficiently and to filter relevant information from noise. Research on expertise suggests that these schemas are acquired through experience and repeated exposure to domain-specific contexts (Ericsson, Krampe, and Tesch-Römer, 1993). Over time, individuals develop the ability to rapidly interpret complex information and to generate intuitive judgements about potential opportunities. From a neuroscientific perspective, opportunity recognition likely involves interactions between systems responsible for memory, association, and prediction (Bar, 2007; Friston, 2010).

The cerebral continuously compares incoming information with stored representations, enabling individuals to detect similarities between current situations and past experiences. Associative processes allow connections to be formed between previously unrelated concepts, supporting the generation of novel ideas. Predictive processes enable individuals to simulate potential future outcomes and evaluate the viability of opportunities (Clark, 2013). Attention plays a critical role in this process by determining which information is selected for deeper processing (Desimone and Duncan, 1995). Eye-tracking research has shown that patterns of visual attention reflect underlying cognitive strategies, with differences observed between experts and novices (Rayner, 2009). When combined with neural measures such as EEG, eye-tracking provides a means of linking attentional processes with underlying neural dynamics (Dimigen et al., 2011). This integration offers the potential to examine how opportunity recognition unfolds in real time, providing new insights into the mechanisms that support entrepreneurial expertise.

Neuroscience of Decision-Making

Entrepreneurial activity frequently requires individuals to make decisions under conditions characterised by uncertainty, incomplete information, and time pressure (McMullen and Shepherd, 2006). Entrepreneurs must evaluate potential opportunities, assess risk, and allocate resources in environments where outcomes cannot be predicted with certainty. Understanding the neural mechanisms that support decision-making in such contexts is therefore critical for advancing research in neuro-entrepreneurship.

Over the past three decades, neuroscience has made substantial progress in identifying the neural systems involved in human decision-making. Research in cognitive neuroscience and behavioural economics has demonstrated that decision processes arise from interactions among systems responsible for reward evaluation, emotional processing, prediction, and executive control (Bechara, 2005; Rangel et al., 2008; Glimcher and Fehr, 2014). These systems

operate across multiple temporal and functional scales, ranging from rapid intuitive responses to slower, deliberative reasoning processes.

One influential framework for understanding decision-making is the dual-process model of cognition, which proposes that human judgement is shaped by the interaction between two broad categories of cognitive processes. The first system is fast, intuitive, and automatic, allowing individuals to generate rapid responses based on prior experience and learned patterns. The second system is slower and more analytical, supporting deliberate reasoning and strategic evaluation (Daniel Kahneman, 2011; Evans and Stanovich, 2013).

Entrepreneurial decision-making often involves the interaction of these processes. Experienced entrepreneurs may rely on rapid intuitive judgements when identifying opportunities, while also engaging in more deliberate analysis when assessing feasibility and long-term implications (Dane and Pratt, 2007).

A central component of decision-making involves the evaluation of potential rewards and risks. Neural circuits associated with reward processing, particularly dopaminergic pathways, encode the expected value of potential actions and update these evaluations as new information becomes available (Schultz, 1998; Rangel et al., 2008). Activity within these systems reflects both the anticipation of reward and the discrepancy between expected and actual outcomes, commonly referred to as prediction error.

Prediction error signals play a key role in learning and adaptation. When outcomes differ from expectations, these signals enable individuals to update their beliefs and adjust their decision strategies (Rescorla and Wagner, 1972; Schultz, 1998). In entrepreneurial contexts, where feedback is often delayed or ambiguous, the ability to learn from such discrepancies is particularly important.

Emotional processes also contribute significantly to decision-making. Emotional signals provide rapid evaluations of potential outcomes, guiding behaviour in situations where analytical processing may be limited (LeDoux, 2000; Bechara, Damasio, and Damasio, 2000). These signals are particularly relevant in uncertain environments, where individuals must often rely on incomplete information.

At the same time, executive control systems enable individuals to regulate emotional responses, integrate complex information, and maintain goal-directed behaviour (Miller and Cohen, 2001). These systems support planning, cognitive flexibility, and the evaluation of competing alternatives.

Another important feature of decision-making is the role of predictive processing. The cerebral continuously generates expectations about future events and updates these predictions based on incoming information (Friston, 2010; Clark, 2013). This process allows individuals to anticipate potential outcomes and adapt their behaviour accordingly.

In entrepreneurial contexts, predictive processes are essential for evaluating opportunities and anticipating future market conditions. Entrepreneurs must construct mental simulations of possible outcomes and assess the likelihood that particular strategies will lead to success (Grégoire, Barr, and Shepherd, 2010).

These processes occur on rapid timescales, often within milliseconds. Capturing such dynamics requires methods capable of measuring neural activity with high temporal resolution. EEG provides one such method, enabling researchers to observe how neural activity evolves during decision-making (Luck, 2014).

However, neural data alone cannot fully capture the context in which decisions occur. Decision-making is closely linked to perception and attention, which determine how information is sampled from the environment. Understanding these processes requires complementary methods that capture behavioural and perceptual dynamics.

Eye Movements and Visual Attention in Cognition

Understanding how individuals allocate attention within complex environments is central to the study of cognition and decision-making. In entrepreneurial contexts, where individuals must evaluate multiple sources of information under conditions of uncertainty, attentional processes play a critical role in shaping how opportunities are perceived and assessed.

Eye movements provide a direct and continuous measure of visual attention. Patterns of fixation, saccadic movement, and gaze duration reflect how individuals sample information from their environment and prioritise different sources of input (Holmqvist et al., 2011; Rayner, 2009). As such, eye-tracking has become an important tool for studying cognitive processes across a wide range of domains.

Early research demonstrated that eye movements are strongly influenced by task demands and cognitive goals (Yarbus, 1967). Individuals viewing the same visual scene may exhibit markedly different gaze patterns depending on what they are asked to do, highlighting the close relationship between attention and cognition.

Visual attention can be understood as an active process in which individuals selectively sample information to support cognitive tasks (Desimone and Duncan, 1995). Fixations represent moments when information is acquired and processed, while saccades reflect shifts in attention between different regions of interest. The sequence and duration of these movements provide insight into how individuals engage with complex stimuli.

Research has shown that eye movements are closely linked to cognitive processing. Longer fixation durations are often associated with increased processing demands, while patterns of gaze transitions can reveal strategies for comparing alternatives and integrating information (Rayner, 2009).

In decision-making contexts, eye-tracking has been used to examine how individuals gather and evaluate information before making a choice. Gaze patterns often reflect the gradual accumulation of evidence in favour of particular options (Krajbich, Armel, and Rangel, 2010), with individuals tending to focus more on information that supports their eventual decision.

In complex environments, individuals must manage cognitive load by selectively attending to relevant information. Rather than processing all available inputs, they focus on cues that are perceived as most important (Lavie, 2005). These strategies are shaped by experience, expectations, and task demands.

Differences in gaze behaviour between experts and novices have been observed across multiple domains (Ericsson et al., 1993). Experts tend to exhibit more efficient visual search strategies, characterised by fewer but more informative fixations and a greater ability to identify relevant information quickly (Gegenfurtner, Lehtinen, and Säljö, 2011).

In entrepreneurial contexts, such differences may play a key role in opportunity recognition. Experienced entrepreneurs may focus more quickly on critical indicators, such as market needs or scalability, while novices may attend to less relevant features.

Eye-tracking also provides insight into the temporal dynamics of decision-making. By analysing how gaze behaviour evolves over time, researchers can examine how individuals transition from initial exploration to focused evaluation and eventual decision-making (Krajbich et al., 2010).

Despite its strengths, eye-tracking alone cannot reveal the neural processes underlying cognition. While it indicates where attention is directed, it does not capture how information is processed within the cerebral. Integrating eye-tracking with neural measures therefore provides a more complete understanding of cognitive dynamics.

EEG and Neural Dynamics of Decision Processes

Electroencephalography (EEG) provides a powerful method for studying the neural dynamics of cognition. By measuring electrical activity generated by neural populations, EEG allows researchers to observe cerebral activity with high temporal resolution, capturing rapid changes in neural processing (Luck, 2014; Cohen, 2014).

One of the key features of EEG data is the presence of neural oscillations, which occur across different frequency bands and are associated with distinct cognitive functions (Buzsáki, 2006). These oscillations provide insight into how the cerebral coordinates activity across different regions during cognitive tasks.

Theta-band activity has been linked to cognitive control, error monitoring, and the processing of uncertainty (Cavanagh and Frank, 2014). In decision-making contexts, increases in theta activity are often observed when individuals encounter conflicting information or must resolve competing alternatives.

Alpha-band activity is commonly associated with attentional processes. Changes in alpha power reflect the allocation of attention, with decreases in alpha activity indicating increased engagement with relevant stimuli (Klimesch, 2012).

Beta-band activity has been associated with the maintenance of cognitive states and decision stabilisation (Engel and Fries, 2010). During decision-making, beta oscillations may reflect the consolidation of a chosen option once sufficient evidence has been accumulated.

In addition to oscillatory activity, EEG research often examines event-related potentials (ERPs), which are neural responses that are time-locked to specific stimuli or events (Luck, 2014). These signals provide insight into different stages of cognitive processing, including attention, evaluation, and error detection.

Prediction error signals are particularly relevant for decision-making. These signals reflect the difference between expected and actual outcomes and play a central role in learning and adaptation (Schultz, 1998; Holroyd and Coles, 2002). EEG allows researchers to examine the temporal dynamics of these processes, revealing how the cerebral updates its expectations in response to new information.

EEG has also been used to study evidence accumulation, a process through which information is gradually integrated until a decision threshold is reached (O'Connell, Dockree, and Kelly, 2012). Neural signals associated with this process reflect the build-up of activity leading to a response, providing insight into how decisions emerge over time.

Another important application of EEG is the measurement of cognitive workload. Changes in neural activity can indicate variations in processing demand, allowing researchers to assess how task complexity influences cognitive effort (Cohen, 2014).

One of the strengths of EEG is its compatibility with other measurement techniques, including eye-tracking. By aligning neural data with eye-movement events, researchers can examine how cerebral activity changes in relation to attention (Dimigen et al., 2011). This enables the investigation of how specific pieces of information are processed during decision-making.

In entrepreneurial contexts, EEG provides a means of observing how individuals evaluate opportunities at a neural level. Combined with eye-tracking, it offers the potential to construct a detailed picture of how attention and neural processing interact during decision formation.

Integrating Eye-Tracking and EEG

Understanding complex decision-making requires more than observing behaviour or neural activity in isolation. Decisions emerge through the interaction of perceptual processes, attentional dynamics, and neural computations

that unfold continuously over time (Cisek and Kalaska, 2010; Gold and Shadlen, 2007). To capture these interactions, researchers increasingly employ multimodal approaches that combine complementary measurement techniques. Among these, the integration of eye-tracking and EEG represents a particularly powerful method for investigating cognition in real time.

Eye-tracking and EEG provide distinct but complementary perspectives on cognitive processing. Eye-tracking reveals where and when individuals allocate visual attention, offering a behavioural index of information sampling (Holmqvist et al., 2011). EEG captures the neural dynamics associated with perception, evaluation, and decision formation with high temporal precision (Luck, 2014; Cohen, 2014). When combined, these methods enable researchers to examine how neural activity evolves in relation to attentional selection (Dimigen et al., 2011).

The integration of these modalities is grounded in the recognition that attention and neural processing are tightly coupled. Visual attention determines which information enters cognitive processing, while neural systems evaluate and interpret that information (Desimone and Duncan, 1995). By linking these processes, multimodal approaches allow researchers to trace the flow of information from perception to decision.

A central concept in this integration is the analysis of gaze-locked neural activity. In this approach, EEG signals are aligned with specific eye-movement events, such as fixation onset, enabling the examination of neural responses associated with processing particular elements of a visual environment (Dimigen et al., 2011).

For example, when an individual fixates on a specific feature within a decision scenario, EEG data can be analysed to determine how the cerebral responds during that moment. This enables the identification of neural signatures associated with evaluation, uncertainty, or reward processing in relation to specific informational cues (Cohen, 2014).

This approach provides a dynamic view of cognition, capturing the continuous interplay between attention and neural activity. Rather than treating cognition as a sequence of discrete stages, it allows researchers to observe how information is processed incrementally as individuals interact with complex environments (Cisek and Kalaska, 2010).

Another important aspect of multimodal integration is the ability to examine temporal coordination between attention and neural dynamics. By synchronising eye-tracking and EEG data, researchers can investigate how shifts in attention correspond to changes in neural activity.

For instance, neural signals associated with cognitive control or attentional engagement may increase following fixation on a task-relevant stimulus, reflecting the allocation of processing resources (Klimesch, 2012). Similarly, signals associated with uncertainty or conflict may emerge when individuals encounter ambiguous or competing information (Cavanagh and Frank, 2014).

Multimodal approaches also enable detailed analysis of information sampling strategies. Eye-tracking reveals the sequence in which individuals explore different elements of a scenario, while EEG provides insight into how each element is processed. This allows researchers to examine both what information is attended to and how it influences decision-making (Krajbich et al., 2010).

In entrepreneurial contexts, these methods offer a unique opportunity to study how individuals evaluate opportunities in real time. Entrepreneurs often engage with complex and multidimensional information, requiring them to prioritize certain cues while ignoring others. Understanding how attention and neural processing interact in this context is essential for uncovering the mechanisms of entrepreneurial expertise.

The integration of eye-tracking and EEG therefore provides a comprehensive framework for studying cognition as it unfolds, capturing both perceptual and neural processes. This approach represents a significant advancement over traditional methods, enabling a more detailed understanding of decision-making dynamics.

Neuro-Entrepreneurship Experimental Paradigms

As neuro-entrepreneurship has developed, researchers have sought to design experimental paradigms that capture the cognitive processes underlying entrepreneurial behaviour. While traditional approaches have relied on surveys and retrospective analysis, experimental methods provide a means of observing decision-making in controlled settings (Nicolaou and Shane, 2014).

One common approach involves opportunity recognition tasks, in which participants evaluate potential business ideas or scenarios (Grégoire et al., 2010). These tasks have been used to examine how individuals differ in their ability to identify viable opportunities. Findings suggest that experienced entrepreneurs are more effective at distinguishing high-potential opportunities from less promising ones.

However, such tasks often capture decision outcomes rather than the processes leading to those outcomes. Participants typically provide a single response after evaluating a scenario, making it difficult to observe how their evaluations evolve over time.

Another approach involves risk evaluation tasks, often adapted from behavioural economics paradigms (Kahneman and Tversky, 1979). These tasks examine how individuals make choices under conditions of uncertainty. While useful for understanding general decision tendencies, they may not fully capture the complexity of entrepreneurial decision-making, which often involves interpreting ambiguous and multidimensional information.

To address these limitations, some researchers have developed simulation-based paradigms that more closely resemble real-world decision environments. These simulations allow participants to engage in ongoing decision-making, responding to changing conditions and feedback.

Simulation-based approaches offer greater ecological validity and enable the study of decision-making as a temporal process (Cisek and Kalaska, 2010). However, they also introduce challenges, including increased complexity and difficulty isolating specific cognitive mechanisms.

The incorporation of neuroscientific methods into experimental paradigms has provided new opportunities for studying entrepreneurial cognition. Techniques such as EEG allow researchers to observe neural activity during decision-making tasks, providing insight into underlying cognitive processes (Luck, 2014).

Similarly, eye-tracking enables the analysis of how individuals allocate attention during decision tasks (Holmqvist et al., 2011). By examining gaze behaviour, researchers can infer how individuals prioritise information and navigate complex environments.

Despite these advances, relatively few studies have fully integrated EEG and eye-tracking within entrepreneurial contexts. As a result, there remains a gap in understanding how neural and attentional processes interact during opportunity evaluation.

This gap highlights the need for experimental paradigms that capture cognition as a dynamic and interconnected process, integrating behavioural, perceptual, and neural data.

Experimental Framework

Building on the preceding sections, this assessment proposes a novel experimental framework for studying entrepreneurial decision-making as a dynamic, temporally unfolding process. Rather than treating decisions as discrete outcomes, the framework conceptualizes decision-making as an evolving interaction between attention, prediction, evaluation, and neural adaptation.

This perspective aligns with contemporary models of cognition that emphasise continuous evidence accumulation, predictive processing, and action-oriented decision dynamics (Gold and Shadlen, 2007; Friston, 2010).

The central aim is to capture how decisions emerge over time, reflecting the continuous interplay between perception and neural processing. Participants are presented with entrepreneurial decision scenarios that simulate real-world opportunity evaluation. These scenarios may include business proposals, market data, product concepts, and financial information. Participants are asked to evaluate these scenarios and make decisions, such as whether to pursue an opportunity or which option to select. Crucially, participants are free to explore the information visually, allowing natural patterns of attention to emerge. This design reflects an ecological approach to cognition, in which behaviour is studied within environments that approximate real-world complexity (Cisek and Kalaska, 2010).

Eye-Tracking: Attentional Dynamics

Eye-tracking is used to measure how participants allocate attention during the task. Key metrics include fixation duration, fixation frequency, and scan paths (Holmqvist et al., 2011).

These measures provide insight into how individuals prioritise information, identify relevant cues, and navigate complex decision environments. Patterns of gaze behaviour can also reveal differences in strategy, such as whether individuals adopt broad exploratory approaches or more focused evaluative strategies.

EEG: Neural Decision Dynamics

EEG is used to capture neural activity throughout the decision process. Key indicators include oscillatory activity associated with attention, cognitive control, and decision-making (Cohen, 2014), as well as event-related potentials linked to evaluation and outcome processing (Luck, 2014).

These measures provide insight into how the cerebral responds to information and how decisions evolve at a neural level, including processes such as prediction error signalling and evidence accumulation.

Gaze-Locked Neural Analysis

A central feature of the framework is the alignment of EEG data with eye-movement events. By analysing neural activity in relation to specific fixations, researchers can examine how particular pieces of information are processed (Dimigen et al., 2011).

This approach enables the direct linking of attention and neural dynamics, providing a detailed view of how decisions are constructed in real time.

Temporal Decision Modeling

The framework conceptualizes decision-making as a sequence of dynamically evolving phases, including:

- Initial exploration
- Focused evaluation
- Evidence accumulation
- Decision commitment

This phase-based structure is consistent with models of decision-making that emphasise gradual accumulation of evidence leading to threshold-based decisions (Gold and Shadlen, 2007).

Importantly, these phases are not strictly sequential but may overlap and interact dynamically, reflecting the fluid nature of real-world decision-making.

Individual Differences and Expertise

The framework also enables the study of individual differences in decision-making. By comparing patterns across participants, researchers can identify differences in attentional strategies, neural responses, and decision dynamics.

These differences may provide insight into the mechanisms underlying entrepreneurial expertise, including the development of efficient information sampling strategies and adaptive predictive models (Ericsson et al., 1993; Baron, 2006).

Summary

The proposed framework integrates eye-tracking and EEG to create a comprehensive method for studying entrepreneurial cognition. By capturing the interaction between attention and neural processing, it provides a dynamic view of decision-making that extends beyond traditional approaches.

In doing so, it advances neuro-entrepreneurship toward a process-oriented, neuro-dynamic understanding of entrepreneurial behaviour.

Implications for Research and Training

The integration of neuroscience and attentional measurement into entrepreneurship research has important implications that extend beyond theoretical advancement. By enabling the observation of decision-making as a dynamic, real-time process, the framework proposed in this assessment provides new opportunities to reshape how entrepreneurial cognition is studied, taught, and developed in practice.

Traditional approaches to entrepreneurship education and research have relied heavily on outcome-based assessments, such as business performance or opportunity selection (Shane and Venkataraman, 2000). While these approaches provide valuable information, they offer limited insight into the processes through which decisions are formed (Foss and Klein, 2012). As a result, much of entrepreneurial training has focused on teaching frameworks and models without directly addressing the underlying cognitive mechanisms that support effective decision-making.

This assessment suggests that entrepreneurial expertise may be more accurately understood as a function of how individuals perceive, attend to, and interpret information (Mitchell et al., 2007; Baron, 2004). This shift in perspective has significant implications.

For research, it highlights the importance of moving toward process-oriented paradigms that capture the temporal dynamics of cognition. The integration of EEG and eye-tracking enables researchers to observe how decisions unfold, providing insight into mechanisms that would otherwise remain inaccessible (Dimigen et al., 2011; Cohen, 2014).

For education, it suggests a need to focus not only on knowledge acquisition but also on the development of attentional and perceptual skills. Training individuals to identify relevant signals, prioritise information, and navigate complex environments may be critical for enhancing entrepreneurial capability (Ericsson et al., 1993).

For professional development, multimodal approaches offer the potential for personalised feedback and coaching. By analysing patterns of attention and neural activity, it may be possible to identify strengths and areas for improvement, supporting more targeted interventions.

These developments also open the possibility of technology-assisted decision support systems, which could provide real-time feedback on cognitive states and support more effective decision-making (Glimcher and Fehr, 2014).

Literature Gaps

The field of neuro-entrepreneurship remains in its early stages, and significant opportunities exist for further development.

One important direction involves moving beyond laboratory settings toward real-world environments. Advances in portable EEG and mobile eye-tracking technologies make it increasingly feasible to study decision-making in naturalistic contexts, enhancing ecological validity (Debener et al., 2012).

Another direction involves integration with artificial intelligence and data analytics. Multimodal datasets combining neural and behavioural data can be analysed using machine learning techniques to identify patterns and develop predictive models of decision-making (Glimcher and Fehr, 2014).

Longitudinal research represents another important opportunity. By examining how cognitive and neural processes evolve over time, researchers can gain insight into the development of entrepreneurial expertise (Ericsson et al., 1993).

Future work should also expand the scope of investigation to include additional cognitive and affective processes, such as creativity, emotional regulation, and social interaction. These processes are likely to play important roles in entrepreneurial behaviour but remain underexplored within neuro-entrepreneurship.

At a broader level, these developments point toward the emergence of a neuro-dynamic theory of entrepreneurship, in which entrepreneurial behaviour is understood as an emergent property of interacting neural, cognitive, and environmental processes (Friston, 2010; Clark, 2013).

Conclusion

Entrepreneurial decision-making has long been recognised as a complex process shaped by uncertainty, experience, and the interpretation of evolving information (McMullen and Shepherd, 2006). Traditional approaches have provided valuable insights but have been limited in their ability to capture the processes through which decisions are formed. This assessment has advanced a neuro-dynamic perspective on entrepreneurial cognition, integrating insights from neuroscience, attention research, and entrepreneurship studies. Central to this perspective is the recognition that decision-making is not a static event but a continuous process that unfolds over time (Gold and Shadlen, 2007). By combining eye-tracking and EEG, researchers can observe how attention and neural activity interact during decision-making, providing a more detailed understanding of how opportunities are evaluated and decisions are made (Dimigen et al., 2011). The proposed experimental framework offers a novel approach to studying entrepreneurial cognition, shifting the focus from outcomes to processes. This approach has the potential to transform research, education, and practice, enabling a deeper understanding of entrepreneurial expertise and supporting the development of more effective training and decision support systems. Ultimately, this work highlights the importance of understanding not just what decisions are made, but how those decisions emerge. By making the processes of perception, evaluation, and choice visible, neuro-entrepreneurship offers a powerful new lens for studying human decision-making.

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