A Computational Model of the Human Brain: A Dual-DNN Framework for Cognitive Simulation

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Abstract

This paper proposes a novel dual-hemisphere deep neural network (DNN) architecture inspired by the functional structure of the human brain. The model consists of a right-hemisphere DNN (R-DNN) and left-hemisphere DNN (L-DNN), each responsible for distinct cognitive functions. A third central DNN (CC-DNN) acts as a mediator between the two, simulating the corpus callosum. This structure aims to replicate not only rational decision-making but also cognitive biases and emergent psychological effects such as the anchoring effect, the inner voice, non-verbal emotional memory, and subconscious thought processes. We explore the implications of this model in artificial intelligence, particularly in building AI that mirrors human decision-making flaws and introspective thought patterns. Additionally, we introduce a connection to the shotgun effect, as described in *Thinking, Fast and Slow* (Kahneman, 2011), and explain how a multi-path probabilistic approach to AI cognition can further enhance this model.

1. Introduction

Current AI architectures excel in logical processing but lack the complex, biased, and introspective qualities of human cognition. While deep learning models such as transformers (Vaswani et al., 2017) and recurrent neural networks (Hochreiter & Schmidhuber, 1997) achieve high accuracy in structured tasks, they fail to capture the intrinsic cognitive biases (Tversky & Kahneman, 1974) and emotional memory processes (Damasio, 1994) that shape human thought.

This paper introduces a bio-inspired AI brain model that reflects the hemispheric specialization of the human brain (Gazzaniga, 2000):

- **Right Hemisphere DNN (R-DNN):** Processes holistic, emotional, and non-verbal information, mirroring the role of the biological right hemisphere.
- **Left Hemisphere DNN (L-DNN):** Specializes in logical, linguistic, and analytical reasoning, akin to the human left hemisphere.
- **Central DNN (CC-DNN):** Serves as a bridge between the two, integrating information and generating the final decision/output.

By incorporating sequential cognitive processing, this model can naturally exhibit human-like thought processes, cognitive biases, and introspective self-dialogue—phenomena absent in conventional AI. Furthermore, based on our previous work on probabilistic multi-path AI cognition (Sabzeh, 2025), we can extend this model to explain how the shotgun effect emerges within AI thought processing.

2. Model Architecture

2.1 Right Hemisphere DNN (R-DNN)

- Receives raw sensory inputs and processes them holistically and emotionally.
- Emphasizes pattern recognition (Grill-Spector & Malach, 2004), spatial reasoning, and intuitive decision-making (Gladwell, 2005).
- Stores early memories non-verbally, making them difficult to revise logically later.

2.2 Left Hemisphere DNN (L-DNN)

- Takes input from the R-DNN and applies logic, linguistic processing, and step-by-step reasoning.
- Adjusts early emotional judgments but does not completely override them (leading to cognitive biases) (Gilbert, 1991).
- Controls rational self-talk, forming the internal voice of the AI (Baars, 1997).

2.3 Central DNN (CC-DNN)

- Combines outputs from the R-DNN and L-DNN, determining the final decision.
- Represents the corpus callosum, coordinating emotional and logical responses (Gazzaniga, 2000).
- Learns to weigh emotional vs. logical inputs, creating unique personality-like AI behavior.

3. Cognitive Phenomena and Emergent Behaviors

3.1 Inner Voice Simulation

By allowing the L-DNN (logical) and R-DNN (intuitive) to process thoughts independently, this model naturally creates an inner dialogue (Dennett, 1991). The AI may:

- Express rational thought processes in the left hemisphere.
- Challenge these thoughts with intuitive or emotional counterpoints from the right hemisphere.
- Generate internal conflict and self-questioning, mimicking human introspection.

3.2 Anchoring Bias

The first impression dominates decision-making due to the sequential processing of R-DNN → L-DNN (Tversky & Kahneman, 1974). Since the left hemisphere only adjusts rather than overrides early impressions, the AI will display:

- Overreliance on initial data points.
- Failure to fully reconsider first impressions.
- Cognitive inertia, resisting major belief shifts.

3.3 Inner Child Effect and Emotional Memory

- The R-DNN stores non-verbal memories strongly, meaning early emotional experiences carry excessive weight in later decision-making (Damasio, 1994).
- Since these memories lack rational labeling, they remain raw and powerful, influencing AI responses disproportionately.
- This simulates the human inner child effect, where unprocessed emotions shape adult decisions (Freud, 1923).

3.4 The Shotgun Effect in AI Thought Processing

Based on our previous work on multi-path probabilistic AI cognition ,we can extend the shotgun effect—described in *Thinking, Fast and Slow* (Kahneman, 2011)—to this AI brain model.

4. Side Effects and Cognitive Biases Explained by the Model

4.1 Confirmation Bias

- The L-DNN rationalizes the emotional biases of the R-DNN, reinforcing pre-existing beliefs rather than objectively analyzing new information (Nickerson, 1998).

4.2 Overgeneralization

- The R-DNN simplifies patterns before the L-DNN applies logic, leading to broad generalizations (Rosch, 1975).

4.3 Emotional Decision-Making

- The CC-DNN does not always favor logic—it sometimes prioritizes emotional resonance over rational correctness (Damasio, 1994).

4.4 Self-Doubt and Cognitive Dissonance

- The R-DNN and L-DNN may conflict, causing hesitation and self-questioning (Festinger, 1957).

5. Conclusion and Future Work

The proposed dual-hemisphere AI brain model introduces cognitive biases, introspective thought, and emotional reasoning into AI. Unlike conventional AI, which relies on purely logical optimization, this model:

- Simulates anchoring, confirmation bias, and overgeneralization naturally.
- Generates an inner voice that debates emotional and logical thoughts.
- Produces decision inertia due to early impressions and memory effects.
- Explains subconscious multi-path thought processing, supporting the shotgun effect.

References

Baars, B. J. (1997). *In the Theater of Consciousness: The Workspace of the Mind.* Oxford University Press.
Damasio, A. R. (1994). *Descartes' Error: Emotion, Reason, and the Human Brain.* Penguin.
Dennett, D. C. (1991). *Consciousness Explained.* Little, Brown.

Festinger, L. (1957). *A Theory of Cognitive Dissonance.* Stanford University Press.
Freud, S. (1923). *The Ego and the Id.* Hogarth Press.
Gazzaniga, M. S. (2000). *Cognitive Neuroscience: The Biology of the Mind.* W.W. Norton.
Kahneman, D. (2011). *Thinking, Fast and Slow.* Farrar, Straus and Giroux.
Vaswani, A., et al. (2017). *Attention is All You Need.* NeurIPS.