

Screen Time and Neural Basis of Impulsivity

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“Digital Natives: A Scientific Perspective on a New Generation”

- The concept of ‘Digital Natives,’ first introduced by Marc Prensky (2001), defines a generation that has grown up immersed in digital technology, the internet, and virtual spaces.
- Unlike ‘**Digital Immigrants**’ who adapted to these technologies later in life,
- **Digital Natives** have never experienced a world without ubiquitous digital connectivity, smartphones, and social media. For them, digital tools are not external add-ons but an intrinsic part of their environment and daily existence, profoundly shaping their development.”

The human brain, particularly during childhood and adolescence, is characterized by remarkable **neuroplasticity**.

This period represents a critical window for neural circuit formation, profoundly shaped by early experiences.

The integration of digital stimuli from the virtual world into daily life presents unique opportunities and significant challenges for brain development.

- Excessive social media use may be linked to changes in the developing brain, affecting impulse control, emotional learning, and behavioral flexibility.
- these changes can contribute to difficulties in managing emotions, making impulsive decisions, and experiencing cognitive inflexibility.

Impulsivity is a multifaceted concept that captures :

- an inability to wait
- a preference for risky outcomes
- a tendency to act without forethought
- an insensitivity to consequences
- and/or an inability to inhibit inappropriate behaviors

- Because it touches on so many different aspects of behavior, impulsivity connects to a number of other concepts including patience, self-control, delay of gratification, intertemporal choice, discounting, risky choice, risk taking, inhibitory control, and sensation seeking

Varieties of impulsivity

○ impulsive choice (or decision making)

1. Delay of Gratification Test

○ impulsive action (or disinhibition)

1. Go/No-Go task
2. Continuous Performance Test (CPT)
3. Stop-Signal Task

Media Effects on Impulsivity !?

- Excessive social media use may be linked to changes in the developing brain, affecting impulse control, emotional learning, and behavioral flexibility.
- these changes can contribute to difficulties in managing emotions, making impulsive decisions, and experiencing cognitive inflexibility.

- Chronic exposure to social comparison and validation cycles within social media platforms may alter serotonergic and dopaminergic signaling pathways that regulate mood, reward, and impulse control in adolescents.

- Reduced serotonergic tone resulting from excessive social media engagement has been hypothesized to contribute to heightened mood instability, anxiety, and impulsive behavior patterns.
- Persistent serotonergic dysregulation may underlie the affective volatility and impulsivity observed in adolescents heavily engaged with social media stimuli.

- The results of the two cross-sectional studies –both among U.S. samples– pointed at positive associations between television viewing and video game playing with teacher ratings of impulsivity
- Gentile et al. found evidence for bidirectional associations between overall and violent video game playing and impulsivity among Singaporean children.

- Boer et al. (2020) found that an increase in Dutch adolescents' social media use problems was associated with an increase in their impulsivity level one year later, but not vice versa.
- The limited empirical work shows that the pacing of media seems to be unrelated to children's impulsivity (Anderson et al., 1977) but that violent content seems to be related to higher levels of impulsivity

○ **Social media use** → ↑ **Impulsivity** → ↑ **ADHD symptoms**

○ Elevated social media and smartphone screen time may contribute to an increase in impulsivity, which in turn predicts longitudinal growth in ADHD symptoms during adolescence.»

Core Neural Hubs of Impulsivity

- **Prefrontal Cortex (PFC):**

Executive control and response inhibition

- **Striatum (Ventral/Dorsal):**

Reward valuation and motivational drive

- **Amygdala and Anterior Cingulate Cortex (ACC):**

Emotional regulation and conflict monitoring

HOW ... ?

- **Hyperactivation of dopaminergic reward circuits**
 - (ventral striatum, nucleus accumbens, vmPFC)

- **Hypoactivation of inhibitory control regions**
 - (dlPFC, rIFG)

- **Imbalance in fronto-striatal neurotransmission**
 - (dopamine, norepinephrine, and serotonin)

- **Impaired Sustained Attention:** Constant interaction with fast-paced, diverse, and often fragmented digital content (e.g., TikTok, rapid-fire gaming) can affect the brain's capacity for sustained attention on a single task.
- Research suggests a correlation between excessive digital media use and reduced gray matter volume in the PFC and attention-related regions (e.g., Brand et al., 2016; Liu et al., 2017).

- **Challenges in Impulse Control and Decision-Making:** The digital environment often provides immediate rewards and instant feedback. This can condition the brain's reward system to seek rapid gratification, potentially leading to difficulties in delaying gratification for larger, long-term rewards, thereby impacting the development of impulse control and logical decision-making.

Impact on Social and Emotional Neural Networks:

- The social brain undergoes significant reorganization during adolescence. While virtual spaces offer connection opportunities, they can influence the depth and quality of these interactions.
- **Amygdala and Emotional Regulation:** Heavy social media use and social comparison can affect the amygdala (involved in emotional processing) and emotional regulation circuits, potentially leading to increased anxiety, depression, and mood lability.
- **Default Mode Network (DMN):** This network is active during introspection, self-reflection, and social cognition. Constant digital engagement may reduce opportunities for DMN activation, which is vital for self-awareness and social understanding.

Thank you for your attention.

