Neurocognitive Deficits in Bipolar and ADHD

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Neurocognitive Theories of ADHD

- Most of neurocognitive theories of ADHD have highlighted the role of:
- executive functions,
- attention,
- behavioral inhibition,
- and delay aversion

Executive Functions

- EF comprises higher-order self-regulatory functions, including
- the ability to inhibit,
- plan,
- organize,
- problem-solve,
- use working memory,
- shift attentional set, and maintain attentional set for future goals (Seidman, 2006).

Executive Functions

- the neural substrates underlying EF include a complex network involving:
- prefrontal, parietal, singular, insular, premotor cortices,
- and subcortical (e.g., basal ganglia) regions (Weyandt, 2005).

Behavioral Inhibition

- Deficits in behavioral inhibition or impulse control are central to ADHD (Barkley, 1997).
- Children with ADHD demonstrate impairment in three interrelated inhibitory processes:
- inhibition of the prepotent response to an event,
- stopping of an ongoing response,
- and interference control

Behavioral Inhibition

- Barkley's (1997) model proposed that impairment in this primary domain is linked to secondary impairment of four key EFs that rely heavily on inhibition :
- working memory,
- self-regulation of affect-motivation-arousal,
- internalization of speech,
- and reconstitution (behavioral analysis and synthesis) (Mohlman 2015).

Behavioral Inhibition

The main deficit in ADHD children can be reduced to a single deficiency in the capacity to delay responding to signal, event, or stimulus (Barkley, 1994).

Behavioral Inhibition

This impairment in delayed responding creates a hypersensitivity to immediate signals or events.

This hypersensitivity leads to :

Hyperactivity

Inattention

Behavioral Inhibition

- Functional imaging studies provide evidence to suggest that inhibitory-based deficits are linked to hypoactivation in prefrontal cortex *(Rubia et al., 2005)*
- and the dorsal striatum *(Vaidya et al., 2005)*.

Attention

- Evidence suggests that ADHD is associated with impairment in:
- selective attention (the ability to ignore distracting information when performing a perceptual act on relevant information),
- sustained attention (the ability to sustain attention to relevant information over a relatively long period of time while withholding responses to irrelevant items),

Attention

- Neurophysiological and anatomical findings support the notion of multiple attentional deficits in ADHD, indicating abnormalities
- in the right frontal lobes (sustained attention),
- right parietal lobes (selective attention) (Tsal et al., 2005).

Delay Aversion

- Delay Aversion refers to a difficulty delaying gratification and a tendency to "discount delay" by selecting immediate lesser rewards over delayed greater ones.
- Sonuga-Barke (2003) proposes that two pathways exist that each contribute to the disorder,
- the first being executive dysfunction,
- and the second being deficits in reward processing or DA,

Delay Aversion

- One of the most consistent findings in this domain is that ADHD individuals respond differently to delayed reward *(e.g., Marco et al., 2009)*.
- This may be due to altered signaling of future rewards and higher rate of decay of the value of those rewards (Sagvolden et al. *2005)*.

Delay Aversion

- Functional magnetic resonance imaging (fMRI) studies implicate hypoactivation in the ventral striatum/nucleus accumbens
- and the orbito-frontal cortex in response to cues of anticipated rewards *(e.g., Plichta et al., 2009)*.

Neurocognitive of Bipolar Disorder

- Neuropsychological studies in bipolar disorder not only have documented cognitive disturbances during mood episodes but show performance decrements in attention, memory, and executive functioning when patients are euthymic.
- These cognitive decrements are associated with difficulties in daily functioning *(Altshuler et al., 2007; Bonnin et al., 2010, 2013)*

Neurocognitive of Bipolar Disorder

- Functional neuroimaging studies in bipolar using fMRI have found abnormalities in the prefrontal cortex (e.g., ventrolateral ventromedial, and dorsolateral prefrontal cortex and anterior cingulate),
- The basal ganglia,
- and in the medial temporal lobe (e.g. amygdala, hippocampus, and parahippocampal gyrus; *(for reviews see Phillips2008; Chen et al., 2011).*

Neurocognitive of Bipolar Disorder

- These brain regions subserve emotional processing (emotion generation and emotion regulation)
- as well as cognitive functions such as working memory and various forms of long-term memory (e.g., declarative or episodic memory).

Neurocognitive of Bipolar Disorder

- In bipolar disorder, most studies have found exaggerated amygdala responses in individuals with bipolar disorder while viewing (processing) emotional facial expressions compared to neutral faces *(Van der Schot,et al. 2010; Hassel et al., 2008).*

Neurocognitive of Bipolar Disorder

- many studies using a variety of emotional stimuli have found decreased frontal activation in the vmPFC and vlPFC in bipolar disorder (Malhi et al. 2005; Lagopoulos & Malhi, 2011),
- brain regions involved in providing top-down regulation of exaggerated emotional responses.

Neurocognitive of Bipolar Disorder

- Diler and colleagues (2013) found significantly greater amygdala activation in patients with bipolar disorder relative to patients with unipolar depression in response to both positive and negative emotional stimuli.
- it was also found that elevated left amygdala activation in response to mild, sad, and neutral faces differentiated bipolar depression from unipolar depression *(Almeida et al. 2010)*.

Neurocognitive of Bipolar Disorder

- approximately 30% to 60% of individuals with bipolar disorder exhibit cognitive difficulties when they are euthymic *(Arts et al., 2008; Bora et al., 2009; Robinson et al., 2006; Torrent et al., 2013; Torres et al., 2007).*
- Three cognitive domains appear to be consistently affected:
- attention/processing speed, memory,
- and executive functioning *(Arts et al., 2008; Bora et al., 2009; Robinson et al., 2006; Torres et al., 2007).*

Neurocognitive of Bipolar Disorder

- One question is whether cognitive difficulties in euthymic patients are relatively stable or whether they emerge as a consequence of illness progression.
- Studies that compared first-degree relatives of individuals with bipolar disorder with normal controls revealed lower performance of first-degree relatives mostly in the domains of verbal memory and executive functioning (Arts et al., 2008)

Neurocognitive of Bipolar Disorder

- Studies that analyzed cognitive performance of children or young adults who later developed bipolar disorder or schizophrenia did not find evidence for severe cognitive problems prior to onset of bipolar disorder, whereas there appears to be one for schizophrenia *(Reichenberg et al., 2002; Zammit et al., 2004)*

Neurocognitive of Bipolar Disorder

- longer duration of illness and more mood episodes were associated with more cognitive difficulties in the domains of attention, memory, and executive functioning
- most studies have not found an association between medication dose and cognitive problems in euthymic patients with bipolar disorder